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Materials for the Electrical Industry.

DURING the year just completed the Copper market has, as usual, been subject to varying moods of optimism and despair, but throughout the period the price ruled moderate, values having fluctuated between about £59 and £68 per ton for cash standard, and £62 10s. and £72 for electrolytic, the quotation at the end of December being about £59 15s. for the former and £66 for the latter. The development of large low-cost properties in South America and in Africa, and improved metallurgical processes generally, resulted in output being maintained at a high rate. During the first eleven months of 1925 the production of the leading countries totalled 1,409,000 short tons, compared with 1,459,500 short tons in the complete year 1924. On the other hand, consumption has been very large, as can be imagined, considering the world tendency towards electrification of transport and industry. The importance of the wire-drawing trade is illustrated by the fact that of the total deliveries of copper in America for domestic and foreign markets, no less than 64 per cent. was in the form of wirebars. The leading feature of the market has been the remarkably sustained consumption in America, but Europe also took substantial quantities. Germany's imports, for instance, in January-October, being 192,000 metric tons, against 80,000 metric tons in the same period of 1924. The stocks of refined copper in America fell from 136,000 short tons on December 31st, 1924, to 68,000 tons at the end of November last (the latest figures available), the combined stocks of refined and rough copper showing a loss of 58,000 tons. Latterly, the chief factor has been the depression on the Continent, especially in Germany, where lack of capital and restricted credit facilities have had a very adverse effect, the financial unsettlement in France also being a disturbing element. The copper

market, therefore, closes the year in circumstances not of the happiest, but with hope lingering that 1926 will see improved economic conditions in Europe, accompanied by an enlargement of consumption.

Tin enjoyed active and prosperous conditions, cash standard fluctuating between £229 and £290 per ton, the quotation at the end of the year being at the top. The outstanding feature has been the large consumption, chiefly in America. Output has not responded as might have been expected to the highly remunerative price, mainly because new deposits of importance have not been discovered or brought into production, although new mining ventures are constantly being initiated, which may have effect later on. No doubt there was some increase, on balance, in 1925, but nevertheless consumption exceeded output and the visible supplies of metal were depleted by some 6,000 tons. The outlook depends largely on whether or not consumption in the United States will be maintained. If it is, higher prices will be inevitable.

The consumption of Spelter was so substantial during 1925 that for a long time the Continent was able to consume the bulk of its output, thus necessitating substantial purchases in America to fulfil the requirements of British consumers. The quantities thus absorbed, together with those used in the United States, resulted in a very sharp reduction in the American stocks, which were brought down from over 21,000 short tons at the beginning of the year to about 7,000 tons at the end of November. Latterly, conditions have not been quite so favourable, European consumption having been affected adversely by the economic troubles of Germany. Hence Continental spelter has been available more freely for our market, and values here declined, creating a considerable gap between price levels in the United States and London. The future rests largely on the development of affairs in Germany. During 1925 prompt metal fluctuated between £40 12s. 6d. and £33 10s., the quotation at December 31st being £38 12s. 6d.

On the whole 1925 proved a good year for the Lead industry, production having shown a substantial increase over last year, and having been probably something like 25 per cent. larger than in 1913. This state of affairs arose to a large extent from the remarkable activity in the electrical trades throughout the world, cable-makers having been uninterruptedly busy during the whole year. The demand for storage batteries was also maintained at a very high rate, while the building trade accounted for an excellent consumption of manufactured products. Somewhat strangely, the greatest activity in the market was seen during the summer months, while the shipping strike which ensued in the autumn and the long drawn-out struggle, resulting in delayed arrivals of badly-wanted metal, complicated the position here, involving, as it did, a shortage of supplies. This trouble having passed, the closing weeks of the year saw rather quieter conditions, with some slackening of demand here, and a setback in Continental business, due to the financial and political difficulties which have been rife there. Nevertheless, the outlook is not discouraging, for substantial buying has to be done by consumers here, and an improving tendency should be noticeable in Continental business.

In Rubber the past year was one of outstanding interest, partly owing to the very wide range of prices seen—from 1s. 4¾d. to 4s. 8d. per lb.— and partly because it marked the complete recovery of estates in Malaya and Ceylon from the disastrous effects of the post-war slump. The Stevenson restriction scheme worked uninterruptedly throughout the year, the exportable quota rising from 50 per cent. of standard in January, to 85 per cent. in December, while the Government has already announced that an extra release will be made at the beginning of February, 1926, bringing the exportable quota up to 100 per cent. of the standard. The stocks showed a steady reduction during the first six months of 1925, and the London reserves for a time stood at below 5,000 tons. American consumers were partly to blame for the price movements, for they chose to depress values when even a slight advance would have ensured larger supplies of rubber, and the growing popularity of the balloon tire and the record automobile production forced manufacturers to buy heavily later on at largely increased prices. The higher figures ultimately caused the release of more rubber, and during the latter part of the year the stringency of supplies was not quite so acute. Production during 1926 may possibly overtake consumption, and stocks may recover to more comfortable proportions, especially if the threats from America of the use of very largely increased quantities of reclaimed rubber prove to have a really substantial foundation.

The Electric Railway Outlook.

WHILST a good many orders for electric locomotives and other railway plant are, fortunately, being carried out by British manufacturers for important railways in the Dominions, the optimistic allusions of the Minister of Transport and of the Electricity Commissioners to the "coming" electrification of our main-line railways at home have been considerably discounted by the recent utterances of railway managers and directors, who are not yet convinced that the advantages to be derived from electrification are sufficient to justify the outlay involved. It may be alleged that the finances of the railway companies are not in such a prosperous condition that the directors can justifiably embark on any costly enterprise which does not offer the sure prospect of an immediate return; but they are able to spend large sums on new locomotives and rolling stock, and it is to be regretted that the bulk of this expenditure tends to perpetuate the existing system of traction. With our comparatively short hauls and dense traffic, the conditions are favourable to electrification, and the high price of coal affords an additional incentive. The plea that the adoption of electric traction would deprive the railways of a most profitable source of revenue—the haulage of coal—does not apply to their own case, for they themselves have to pay for the transport of the coal that they use for locomotion; moreover, they pay a large portion of the carriage twice, as they have to carry the coal whilst consuming it.

There is no doubt that large savings in fuel and maintenance costs would be effected by electrification, and the outstanding question is whether the additional capital charges would be covered by these economies and by the increase in the traffic which usually follows electrification. So far as we know, detailed estimates such as the railway managers must have had before them have not been made public; it would be interesting if they were revealed. The newly electrified sections of the Southern Railway have now been in operation for five months, but it is not usual for the railway companies to publish the traffic returns separately for steam and electrical operation; such classified returns would be welcomed.

X-Ray Apparatus.

LAST month the General Committee of the Coventry and Warwickshire Hospital unanimously decided to purchase some German X-ray equipment for the purpose of modernising certain British apparatus which has been in use for 15 years. Apart from the regrettable fact that a body entrusted with public money should be spending it on foreign plant at a time such as the

present, it is surprising that certain committee-men allowed themselves to make the statements with which they are credited in the local and other Press. The Chairman, while admitting that there was no question but that English apparatus could be obtained to do the work just as well, is reported to have said that it was very much heavier, more difficult to manipulate, and about three times more expensive.

Such statements as these are too serious to be ignored, for they convey a misleading impression of the facts and cannot be justified. How does the weight of such apparatus adversely influence its efficiency? Easy manipulation depends entirely on the dexterity of the operator, and this is the first time that we have heard of British outfits being criticised in this connection.

As regards price, it would be interesting to know by what method of calculation the figures quoted by the Committee were arrived at, for couches and screening stands are obtainable in the British market at very much lower prices than those instanced by the Committee. Moreover, no comparison is valid unless it is made on a fair basis, and as is pointed out in our "Correspondence" columns, it should not be forgotten that English manufacturers design their appliances with a view to securing the approval of the X-Ray and Radium Protection Committee of the National Physical Laboratory with respect to the adequate protection of both the patients under treatment and the operators of the equipment. In this respect British apparatus is acknowledged to be far superior, although compliance with the regulations necessarily adds somewhat to its weight and cost, and it is obviously unfair to disregard these facts when comparing it with plant made in a country where safeguards of the same standard are not demanded, or even considered necessary.

We know of no evidence that will justify the charge that English firms are conservative and "well behind Germans and Americans" in this line. This contention is indeed strange in view of the fact that practically the whole of the X-ray equipment in the great London hospitals and other leading institutions in this country is entirely British. Further, as was reported last week, Swedish opinion seems to be just the reverse. An international syndicate agreement restricts the Swedes to the purchase of European apparatus, but they have complained for some time past that certain Röntgen accessories, particularly tubes, are not obtainable in Europe in the same improved form as those made elsewhere. Hence, Swedish medical men have petitioned their Government for the State expropriation of the patents concerned in order that they may be able to import other than German manufactures.

It is a pity that ill-informed officials, by indulging in discussion such as that which took place at Coventry, should be able to do so much harm to an important and enterprising industry.

French Industrial Progress.

THE remarkable rate at which the use of electricity is growing in France was commented upon in the report by Mr. J. R. Cahill, which was reviewed in our last issue. He states that the *per capita* consumption of electricity is advancing at the rate of 20 per cent. yearly, and the electrical industry is kept busy meeting the growing demand. Railway and rural electrification, and the harnessing of water power, are all contributing to the industry's order book, while the domestic market is considered of almost equal importance. Electricity in mining, metallurgy and chemical production is another great source of revenue to the French electrical industry. It might be thought that a goodly share of this work would fall to foreigners, but it appears that the home industry has grown to such a stage of competency that the call for foreign goods is very small. The great electrical firms, by judicious association with large groups which employ electrical machinery, have secured to themselves permanent buyers of their products, reducing the chance of the foreigner to obtain orders to a minimum. It is calculated that a total of 2,000 millions of francs is invested in the electrical manufacturing industry, while it employs 70,000 persons. The electricity supply industry has a capitalisation of 4,500 millions of francs, and gives employment to over 25,000 workmen.

It is not to be wondered at that our exports of machinery to France have been gradually declining since 1921. In that year they were 59,037 metric tons, while in 1924 they were less than half of this. In 1913 the quantity was 47,731 metric tons. As regards electrical imports, it is shown that although there was an increase in the nominal value in 1924, there was actually a decrease—the depreciation of the franc causing a false impression. Exports of electrical goods from France showed a remarkable increase in 1924, the total weight being 23,600 tons, as compared with 16,800 tons in 1923, and 10,100 tons in 1913.

This information merely confirms the already well-known fact that as a market for general electrical goods, France is not likely to improve, being well able to look after herself in this respect.

India as an Electrical Market.

IN this issue we review a report by Mr. T. M. Ainscough, C.B.E., the Senior Trade Commissioner in India. It is pleasing to note that conditions are now more settled, and the financial position of the Government has been strengthened by improved trade. The prosperity of the country was, however, not reflected in the import figures, the explanation appearing to be that the percentage increase in the prices received by the Indian producer was not so great as that in the prices of imported goods. So far as the imports of machinery were concerned, during the period under review the position of British suppliers improved at the expense of the Swedes and Americans, although the total trade was smaller. In the case of imported electrical apparatus, there was also a decrease in the total and in the British share, while that of Germany showed an appreciable increase.

It would appear that a number of excellent opportunities for British electrical manufacturers will occur in the near future, as several important public works are being undertaken, one of the chief of which is the Punjab hydro-electric scheme. Railway electrification is also likely to be greatly extended, and Mr. Ainscough says that the excellence of the plant and materials already supplied for this type of work by British manufacturers has given the latter a good hold on the market.

Electricity on Motor-Ships.

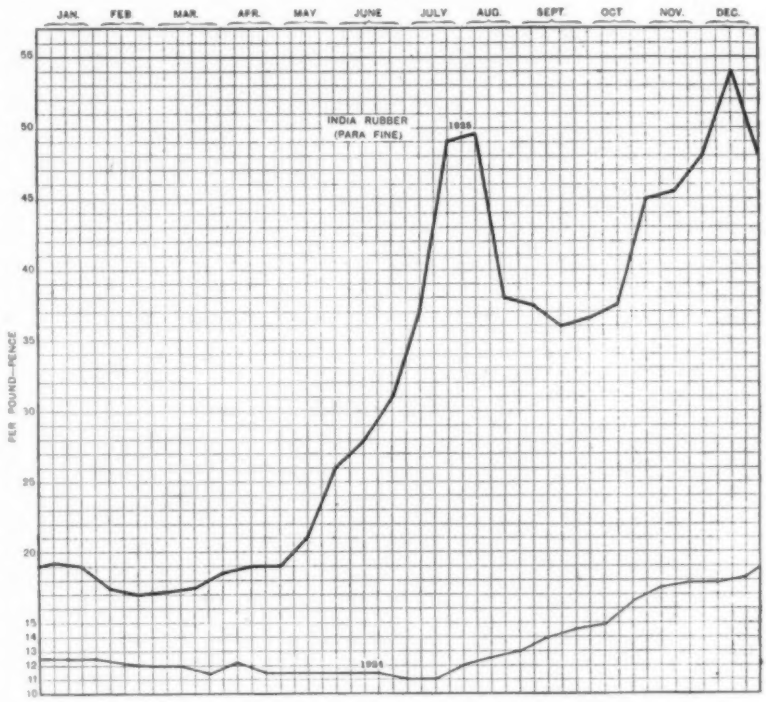
ALTHOUGH the advent of the all-electric ship may not be possible until the key is found to unlock atomic energy, substantial progress is being made in that direction. It is true that electric propulsion is not being adopted on British ships, but it is making headway abroad, and we hope to see it come into its own in the fullness of time. Meanwhile, it is gratifying to observe that the use of electricity for a wide range of applications is rapidly gaining popularity, particularly on board ships propelled by oil engines; as Mr. A. Regnauld shows elsewhere in this issue, not only is all the auxiliary machinery driven by electric motors, but also electricity is used for lighting, heating and cooking in some cases, and for ministering to the comfort of passengers and crew in a variety of ways, these services involving the consumption of about 15 per cent. of the total quantity of oil burnt. Besides giving employment to a large number of workpeople on shore, the development of the electrical department on board ship necessitates the employment of electricians, and it is a significant event that an engineer writes to *The Times* of December 31st drawing attention to the increasing importance of the electrician at sea. He states that the Board of Trade refuses to permit an electrician to rise above the rank of third engineer, and will not grant him a "ticket." Evidently the time is at hand when careful consideration should be given to these questions.

Copper, Lead and Rubber in 1925.

In accordance with our usual practice, we reproduce herewith curves showing the course of copper, lead, and rubber prices during the past two years.

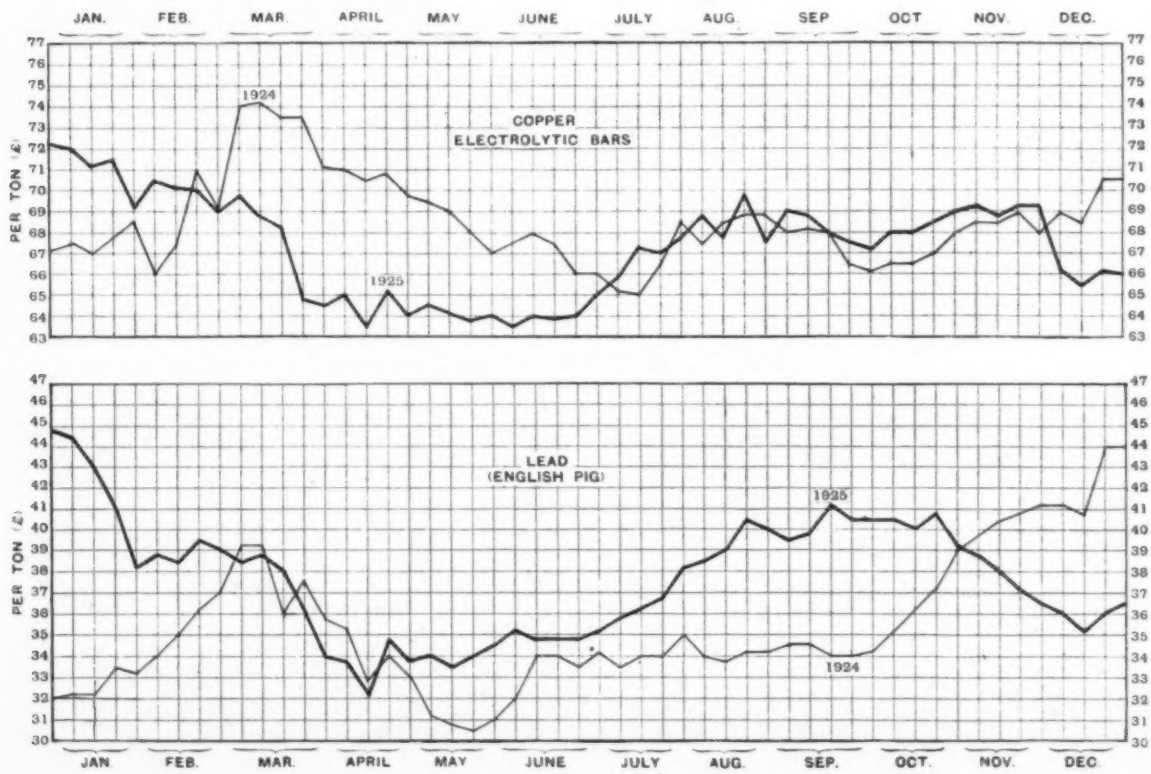
Generally speaking, the price of copper was lower in 1925 as compared with the preceding year, although it commenced the year £5 per ton higher. Upon the point representing the last week in February, the curves met, but from that date up to July there was a considerable difference, the price falling twice during that period of 1925 to £63 10s. per ton, whereas the lowest point reached in 1924 was £65. From July to the end of November the curves kept well together, but towards the close of the year another divergence commenced, and the end of December saw the reverse of the opening position.

The level of lead prices during 1925 was generally above that of 1924. A very large difference at the beginning of the year soon dwindled until in early March the curves crossed and remained fairly closely together right up to July, except that the 1925 curve did not fall to the depth experienced in May, 1924. From July to the end of October the curves gradually separated and then returned. In the closing months of the year the price dropped fairly sharply in contrast to a steady rise at the end of 1924, and lead in the same way as copper finished considerably lower in price than it started.



The past year was a memorable one for rubber, and our curve (which is based upon the figures quoted in our fortnightly table for "para fine") showing the trend of its price during 1925 is in marked contrast to the comparatively uninteresting graph for the preceding year (or that for 1923). The rising tendency which set in towards the end of 1924 was slightly checked in the earlier part of last year. Rubber soon recovered, however, and with phenomenal resiliency sprang upwards to a very high peak in July-August. Thereafter a sharp relapse was experienced, but after hovering around 3s. per lb. for a few weeks there was a fresh upward movement, which took the price to 4s. 6d., followed by another relapse to 4s. 1d. at the close of the year.

On Monday last the highest prices paid for crude rubber were:—Spot 3s. 10d., January 3s. 9¼d., January-March 3s. 8¼d., and April-June 3s. 4½d. An increase in London stocks of crude rubber of 586 tons for the week, brought up the total to 6,129 tons against 29,206 tons a year ago.



Martyrs of Science.

By Dr. W. S. HEDLEY.

THERE has recently been announced the death of Mr. R. G. Blackall from exposure to X-rays, and reference has at the same time been made to the case of Mr. Wilson and Mr. Harnack, the former of whom lost his life and the latter lost both arms from the same cause. As a fellow-worker with the last two, though not a sharer in their heroism, may I be permitted to add a word of sympathy and appreciation and at the same time make comment upon the deplorable fact that we are to-day mourning a recent death due to a danger of which the cause was known, and known to be preventable, well nigh thirty years ago?

Let us get back to dates: Discovery of X-rays, November 8th, 1895. Taking Mr. Campbell Swinton's Radiograph of a hand (ELECTRICAL REVIEW, January 24th, 1896), as the beginning of X-ray work in England, and taking the report of Marcuse (Deut. Med. Work, July 2nd of the same year) as the earliest or amongst the earliest reports of X-ray dermatitis, there was a short period of about five months when the "New Photography" was practised in unsuspecting ignorance of the dangers that lay behind it—heroism had no place here. The danger becoming known, protective measures were at once devised. I find that I wrote in the ELECTRICAL REVIEW, November 12th, of the following year of "Ulcers of a very painful character, and slow to heal, following exposure to the action of the focus tube." Then follows a reference to the necessity for protective measures and suggestions of aluminium plates and envelopment of the tube in black cloth as worth trying against any ill-effects of the "soft" tubes of those days. And other devices kept pace with the increasing power and penetration of the tubes, until to-day we have the elaboration of the "radiographic couch" with its all-metal tube box lined with sheet lead, and its easily-moved protective screens and diaphragms to limit the field of action of the rays. Some of us have even known something of a ray-proof room for the safety of neighbours. Such devices, with our ever-growing knowledge of the output of the X-ray tube, ought to make serious X-ray accidents almost things of the past. It is further to be remembered that by their physical, chemical, and biological effects, the intensity of these rays can be measured, their quality tested by other means, and not least in importance is the process of so-called filtration by which unwanted rays may be filtered out and the operator left in possession of a "bundle" composed chiefly of rays exactly suitable for the work in hand.* May it be assumed—it is a large assumption—that every medical man who handles these rays for treatment upon the living body (and no others should handle them for this purpose) has a fair knowledge of the X-ray tube and the rays it emits, an instructed experience of "dosage" and its measurement by the "erythema unit,"† a practicable experience of the details of its application to the body, an appreciation of its possible dangers, and does he carry out his procedure with the same sense of responsibility that he would bring to bear upon a serious surgical operation? Has he worked in the X-ray room of his hospital? Has he attended post-graduate lectures? Finally, seeing that it is impossible to include such work in an already crowded curriculum, is he in possession of any certificate from a duly authorised body, of his fitness to practise this speciality?

So long as the human factor remains, there must, of course, be accidents, but by adopting such measures as the above it is reasonable to hope and expect that they will be minimised. My experience is that it is the demonstrator who all day long is exhibiting his ray-pierced hand to the crowd, that suffers most. I have a recollection of the early days that it was a showman in the streets of Toronto who became one of the earliest victims of X-ray dermatitis. Those early X-ray days bring back a crowd of X-ray memories. The X-ray arrived in England a comparatively unknown stranger, and was not always received with the warmth and welcome that its potentialities and importance deserved. I was in charge of the Electrical Department of the London Hospital at that time, and it devolved upon me to establish an X-ray section. I looked in vain for a home to lodge it in. Beginning with the house governor, I interviewed the whole staff and, without exception, they declared that, owing to increase of work, the hospital was already crowded to its doors, and this was only too true. At last I approached the chairman. He could only say the same, but I understood him to promise that he would "build one." In view of the possibility that he was getting a little playful at my expense, I retired. (I had good reason to change my estimate of that chairman when shortly afterwards I found myself in spacious and well-equipped quarters in a new building.)

Passing on from that interview, my way lay through one of the wards, and I heard in the corridor the rustle of a silk dress; I noticed that all the patients looked pleased and every member of the staff, male and female, sprang "to attention." It was my first interview with the then matron, Miss Luckes, of revered memory—I was not long in explaining my troubles—"Could she do anything about it?"—a gentle shake of the head plainly answered "No!" I then suggested that I had noticed a large light cupboard—another shake of the head. "Oh, that is the jam cupboard." I then hinted that perhaps other accommodation could be found for the jam—or that "I had noticed several convalescent patients who no doubt would see to its disposal, or, (hesitatingly) the jam might perhaps be left on the top shelves"—another shake of the head, this time of greater amplitude and intensity. "Oh, that would *never* do"—and she was gone. But I thought I saw a gleam of helpfulness in her eye, and I was not altogether surprised when on the next day I saw that that "cupboard was bare" and its door standing invitingly open. I was not slow to avail myself of the invitation, and lost no time in installing the scanty X-ray equipment of that day, *viz.*, my Apps 10-in. sparking coil, and accumulator to "drive" it, a "hard" tube, a "medium," and a "soft" one, a tube stand and a flourescent screen. Such was the genesis of the X-ray Department of the London Hospital.

Dr. Hedley was the writer of an article on "Twenty-five Years' Progress in Electro-Therapeutics," published in the Special Issue of the ELECTRICAL REVIEW celebrating the 25th anniversary of the Journal (November 12th, 1897).

Dr. Hedley, M.D.Ed., M.R.C.S., Eng., who is now living in retirement at Shorts Lodge, Liphook, Hants., was at one time Physician-in-Charge of the Electro-Therapeutic Department of the London Hospital, also, Brig.-Surg. Army. His writings include:—"Therapeutic - Electricity"; "Hydro-Electric Methods in Medicine"; "Current from the Main"; "Scope and Value of Electricity in Medicine," *Lancet*, 1896; "Insomnia in Neurasthenia," Ib. 1893; "Electric Radiant Heat Apparatus," Ib.

* It is not possible by filtration to make X-rays homogeneous, but when by the use of (say) a 0.5-mm. copper filter a certain degree of homogeneousness is obtained, we say the rays have become "homogeneous for biological purposes."

† This is the recognised unit for the biological effects of X-rays, but it recognises only surface effects and does not take account of the intensity falling on structures below the skin, therefore the quantimeter (chemical or electric) which determines the dose at various depths and during the entire exposure must be used.

Motor Coaches for Swiss Railways.

A New Type of One-Man Rail Car.

To meet the requirements of its service during periods when traffic is not heavy, the Lötschberg Railway Co., which operates the Berne-Lötschberg-Simplon section of the Swiss Railways, has recently put in operation two electric motor coaches of somewhat unusual design. The vehicles were built to meet certain special requirements, among which was one that the motors of the vehicles must be capable of developing an hourly output of about 500 h.p. at the wheel tires at a speed of 35 kilo - metres (21.7 miles) per hour, and another that the motors should be as far as possible similar to the spare motors kept on hand for its other electric locomotives, in order that they may be used in case of emergency. In view of these stipulations, it was decided to adopt motors of the type supplied by the Oerlikon Co. to the Bernese " Decree " Railways, which have been in use for a period of five years with complete satisfaction.

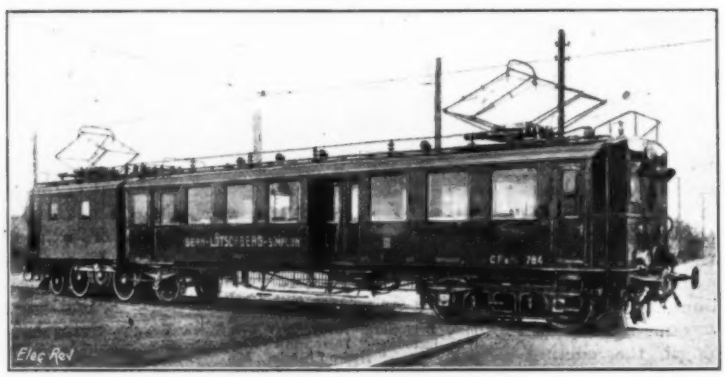


Fig. 1.—New Motor Coach for Swiss Railway.

The electrical equipment of the new coaches, which are somewhat similar in design to those supplied by the Oerlikon Company in 1912 to the Burgdorf-Thun Railway, is concentrated on a truck (fig. 1, left) fitted with a leading axle and two driving axles, the truck being coupled to the main frame carrying the passenger and luggage compartments.

The locomotive portion contains all the electrical control gear (fig. 2). The current, which is single-phase, $16\frac{2}{3}$ cycles at 15,000 V, is led from the overhead collector gear through isolating switches to the main circuit breaker, which is constructed for outdoor mounting, and is arranged for electro-pneumatic closing and for automatic electric release. The second pole of the circuit breaker is connected to the h.p. terminal of the oil-immersed self-cooled transformer. In order to improve the cooling, the transformer is enclosed in a second casing, into which air is drawn through the roof; the air passes over the transformer and escapes into the motor compartment. The low-pressure winding has eleven tappings, which are connected to the motor as required for the various speeds, the highest pressure applied to the motor being about 500 volts; the twelve contactors are controlled electro-pneumatically, and are interlocked.

The fan - ventilated motor has ten poles, a one-hour rating of 518 h.p. at 21.7 m.p.h., and a continuous output of 425 h.p. at 24.2 m.p.h., the highest speed being 40 m.p.h. The two driving axles are coupled together by means of a triangular system of rods, and connected to the motor through a jack shaft; in this way it has been possible to use, not only similar motors to those of the locomotives referred to above, but also the same gearing. The driving wheels are 4 ft. 4 in. in diameter, the gear ratio being 1 to 3.78.

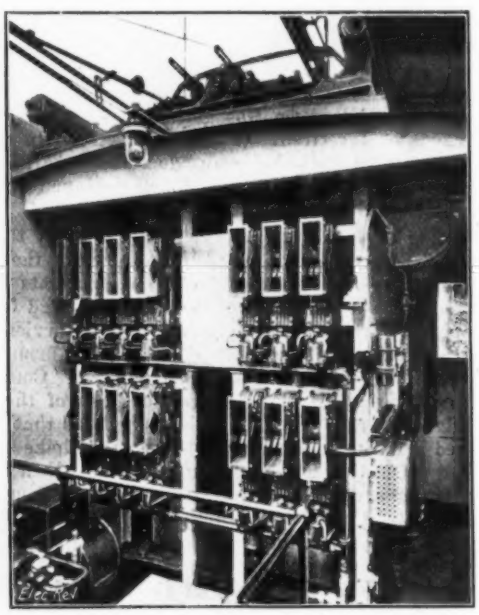


Fig. 2.—Control Gear Behind Driver's Cab.

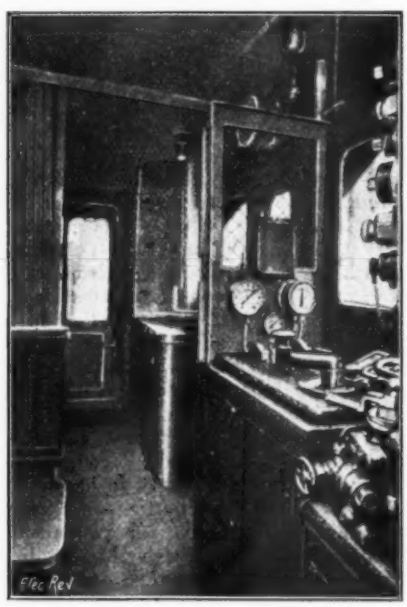


Fig. 3.—Driver's Cab.

The motor coaches are built for multiple control and automatic acceleration, and are intended for one-man operation. Instead of having a " dead man's " handle on the master controller, the safety device is combined with a foot lever which is depressed by the driver during the operation of the motor coach. When the lever is released, the motor circuit opens after a given in-

terval, and the compressed-air brake is brought into action by a relay; if, however, the driver depresses within this interval a push button mounted on the other side of the driver's cab, the switching-off and braking are prevented. This arrangement was adopted in order to facilitate shunting operations, as the driver must then be able to look out from both sides of the cab (fig. 3). To permit the vehicle to be operated in either direction, the passenger coach is provided with a driver's cab at the opposite end to the locomotive.

The direct current at 36 volts for the control circuits and lighting is supplied by a 1-kW motor-generator set and a battery of accumulators. The train heating bus lines are connected to a tapping of the transformer giving 1,000 volts, through an electro-pneumatically operated circuit breaker. The heating current for the driver's cab is obtained from the auxiliary supply system, which serves the compressor set for the brake and the control gear, being connected to the 220-volt tapping of the transformer.

The Oerlikon Maschinenfabrik was responsible for the whole of the electrical equipment, the Swiss Locomotive and Machine Works, of Winterthur, for the chassis and underwork, and the Swiss Industrial Co., of Neuhausen, for the body work. The vehicles have a standard gauge of 4 ft. 8½ in., and are designed to work on a maximum gradient of 1 in 40. At a speed of 21.7 m.p.h., the tractive effort at the wheel rim is 8,800 lb. (one-hour rating), and at 24.2 m.p.h. 6,460 lb. (continuous). The coach is adapted to carry 60 passengers, although five sitting and 15 standing passengers can be accommodated in the luggage compartment. The overall length of the engine proper is 21 ft. 6 in., and of the complete vehicle 71 ft. 8 in.; the total weight of the motor coach is 60.1 tons, of which the electrical equipment is responsible for 15.4 tons.

Electrical Auxiliaries on Motor Ships.

The Rapid Development of the Motor Ship is Leading to the Extended Use of Electrically-driven Auxiliary Machinery.

By ALFRED REGNAULD, B.Sc.(Eng.), Lond., M.I.E.E.

A VERY notable feature of the shipbuilding industry during the few years which have elapsed since the cessation of the Great War has been the almost phenomenal development of the heavy oil engine as a means of propulsion. In Lloyd's Register of Shipping almost the whole of the merchant shipping of the world is classified, and, in addition to publishing its famous "register" every year, Lloyd's Register Society also issues an annual report covering its operations for the year and containing a review of the position of the merchant services of the world. The report covering the year ended June 30th, 1925, has recently been issued, from which it appears that whereas in July, 1919, there were 912 motor-ships of 752,606 gross tons classified in Lloyd's register (the figures for 1914 were only 297 motor-ships of 234,287 gross tons), in July, 1925, there were 2,145 motor-ships of 2,714,073 gross tons. These figures appear even more striking when it is mentioned that of the total tonnage classified during the twelve months ending June 30th, 1919, motor-ships only represented 2.02 per cent., while for the year ending June 30th, 1925, motor-ships classified represented 23.1 per cent. of the total. It is an ill wind which blows nobody any good, and while the economists may lament the rapid growth in the use of oil instead of coal for the propulsion of ships in view of its effect upon the coal mining industry, it is a fact that the development of the motor-ship has been accompanied by a corresponding development in the use of electrically-operated machinery for the various auxiliary purposes on board, such as air compressors, oil fuel, bilge and sanitary pumps, and cargo-handling gear.

On steam engine-driven vessels, with the exception of high-class passenger liners, it is generally considered advisable to employ steam for driving the bulk of the auxiliary machinery, both in the engine room and on deck. Steam is generally available from one or more of the main boilers for stand-by purposes, since it takes a considerable time to raise steam from cold when the vessel is preparing to leave port, while on vessels which stay for considerable periods either a donkey boiler is installed or one of the main boilers is scheduled off for supplying the steam to the auxiliaries. On motor-ships, on the other hand, there is no question of steam being required for stand-by purposes, as soon as the ship is moored, the main engines are completely shut down and one or more auxiliary Diesel-engine-driven generators are started up for supplying power for auxiliary purposes and for operating the cargo winches. In some of the earlier motor-ships steam-driven auxiliaries were employed, and even to-day on vessels which carry oil in bulk it is considered advisable to have steam available for warming the oil to reduce its viscosity for pumping purposes, but a study of the equipment of recent Diesel-engine-driven ships will show that the tendency is towards the complete adoption of electrically-driven auxiliaries.

A glance at the equipment of a few typical motor-ships will serve to indicate the extent to which electrical machinery is being employed at the present time, and will give some idea of the size and nature of that machinery. Consider, first of all, two typical cargo ships, one of small tonnage, used for coasting trade and trade as far as the Mediterranean ports, and the other a cargo liner, such as might be employed for trading to any part of the world. It may be noted in passing that the cargo ship forms the bulk of the mercantile marine of this, or, indeed, any other maritime country, and that it is on vessels of the cargo-carrying class that the widest market for electrical machinery will be found. The small coaster is a vessel 240 ft. long of 3,300 tons displacement, built for the fruit trade between this country and Spanish and Italian ports. She is propelled by a single six-cylinder Diesel engine which develops 1,250 b.h.p. at a speed of 120 revs. per min., giving the vessel a speed of about 11 knots. For operating the various auxiliary machinery she is equipped with three two-cylinder Diesel-engine-driven, direct-current generators of 50-kW capacity, the engines developing about 75 b.h.p. at 250 revs. per min.; at least one of these sets is available as a stand-by. The auxiliary machinery in the engine room comprises air compressors, fuel and lubricating oil pumps, bilge and sanitary pumps, jacket water circulating pumps, &c., all electrically driven, involving the use of about a dozen electric motors varying in size from 1½ h.p. for the fuel oil pump to 80 h.p. for the air compressor. In addition, there are on deck six electrically-driven winches of 16 h.p. each and a windlass driven by a 50-h.p. motor. All these, together with the steering gear, electric light fittings, wireless apparatus, and all the necessary switchgear and wiring, represent a fairly valuable electrical installation.

The second typical motor-ship is 412 ft. long and of 8,000 tons displacement, being propelled by an engine of 3,000 i.h.p. She was built for general cargo work all over the world. In this ship also there are three Diesel-driven generators for supplying current to the

auxiliaries, two of these being three-cylinder sets of 150 b.h.p. and the other a two-cylinder, 100-b.h.p. set, the generators being of 100- and 75-kW capacity respectively. The auxiliary machinery in the engine room is all electrically driven, being somewhat similar to that detailed above, but, of course, of correspondingly greater power, while additional motors are used for driving the machinery in a small workshop and a motor-generator which reduces the generator voltage from 220, at which value it is used for the bulk of the motors, to 110 volts for ship-lighting purposes. The deck machinery comprises 10 electric winches, six being of three tons lifting capacity and four of five tons capacity, together with a five-ton warping winch and a windlass, both electrically driven. The steering gear is of the electric-hydraulic type driven by a constant-speed motor of 12 h.p.

It will be of interest next to consider the electrical equipment of a large motor passenger ship. While, numerically, this class of vessel is not of the same importance as the cargo ship, the aggregate amount of power utilised and therefore the value of the electrical equipment on such a vessel is very much greater. Two large Diesel-engine-driven liners are being built for the services between Southampton and South American ports which are maintained by the Royal Mail Steam Packet Co. These vessels, one of which has already been launched and is expected to run her trials early in the new year, are 655 ft. long and of 22,000 gross tons. They are propelled by two eight-cylinder double-acting four-stroke cycle Diesel engines, each of 10,000 h.p., these units representing the largest marine Diesel units which have been constructed to date. The whole of the auxiliary machinery, with the exception of a steam-driven emergency air compressor, is electrically driven, and, in addition, the lighting and heating of the passenger accommodation, as well as the whole of the cooking, will be carried out by electricity. Current for all purposes throughout the vessel is obtained from four 400-kW generating sets, each driven by a four-cylinder, single-acting, four-stroke Diesel engine. There is, in addition, a 75-kW Diesel-driven generator for emergency purposes fitted in a compartment above the water line for use should the engine room be flooded. The engine-room auxiliaries include three manœuvring air compressors, each driven by a motor of 180 b.h.p., two refrigerating machines, each driven by a motor of 110 b.h.p., and all the necessary pumps and fans for use in conjunction with the refrigerating machinery. In addition, there are the necessary fuel oil, lubricating oil, ballast water, sanitary water, fresh water and bilge pumps, all electrically driven. A feature of these vessels is the deck cranes, which are hydraulically driven, the water under pressure being obtained from pumps which are situated in the machinery space, each being operated by an electric motor of 110 b.h.p. On deck, the electrical equipment includes a 135-h.p. warping winch, two 150-h.p. capstans, a 135-h.p. windlass, and the continuously-running motors for operating the electro-hydraulic steering gear. The watertight doors which are fitted in the various bulkheads are also electrically operated, the control being effected from the bridge, where an indicator shows whether any particular door is open or shut.

The electrical equipment in the passenger accommodation is on a correspondingly large scale, and comprises some 4,000 electric lamps, 500 cabin and ceiling fans, as well as about 500 heaters in the public rooms and cabins. In addition, there are 50 large electrically-driven fans which deliver fresh air through trunkways throughout the accommodation. The cooking throughout the vessels, both for the passengers and the crew, will be done by electricity, and, in addition to the cooking ranges, two large bakers' ovens, the grills, toasters, griddle plates, fish fryers, and salamanders are all electrically heated. Even in the hospital and the barbers' shops electrical equipment is employed comprising kettles, sterilisers, &c., while in the latter electrically-heated hair dryers and vibro-massage machines will be installed.

The Diesel-driven passenger liner *Aorangi*, belonging to the Union Steam-Ship Co. of New Zealand, which, it may be recalled, was completed at the end of last year and has since taken up her station on the service between Vancouver, New Zealand and Sydney, might have been taken as an example of a large passenger motor-ship—she is 580 ft. long and of 17,500 tons gross—but it happens that a number of her auxiliaries as well as the deck machinery are operated by steam. In spite of this, her electrical equipment is very complete, comprising four Diesel-driven generators of 300 kW each, three of which are required to carry the load, one serving as a stand-by. It will serve to illustrate the extent to which power is required on board ship for operating the auxiliaries if figures giving the fuel consumption of the *Aorangi* are quoted. On a recent voyage the total fuel consumption was found to be 43.6 tons per day for the main engines and 9.4 tons per day for the auxiliaries, the latter representing 17.7 per cent. of the total. It is not stated what proportion of the auxiliary consumption was used for steam raising, but, in any case, the figures may be regarded as a proof of the rough-and-ready rule that of the total power required on board ship about 15 per cent. is utilised for driving the auxiliaries.

With the development of the motor-ship the interesting fact emerges that approximately one-seventh of the total power utilised in operating the ships of the merchant services of the world will one day be utilised in the form of electrical energy. This represents an enormous amount of electrical equipment in the form of generators, motors, switchgear, &c., all of which can be economically and efficiently manufactured in this country. Lord Inverforth, in his recent presidential address to the Institute of Marine Engineers, gave it as his considered opinion that after long experience with steamships, when all allowances are made for the greater first cost of the motor-ship, it is, especially in running costs, a more economical proposition. He specially mentioned the electrically-operated deck machinery as being very economical, and quoted the average fuel consumption per day for electric winches as being 0.6 ton of oil as against for steam winches 1½ tons per day, with oil-fired boilers, and four tons per day with coal-fired boilers. Electric winches have often been criticised on the score of unreliability, but while this criticism may have been more or less justified in the past, it is certainly not justified to-day with any of the reputed makes. The same criticism might have been—and, indeed, has been—levied against all electrical machinery on board ship, but experience has shown that where care is taken in the design and manufacture to keep in mind the peculiar conditions under which such machinery is to operate, then electrical machinery is second to none, both in economy and reliability.

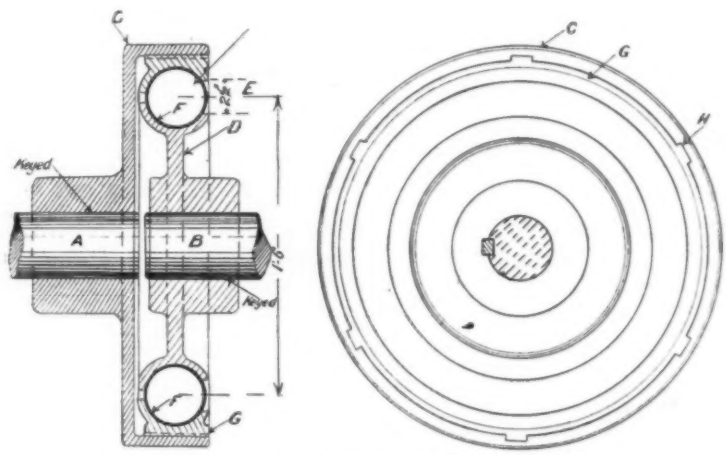
Variation of Radio Station Bearings.—The Radio Research Board (Department of Scientific and Industrial Research) has published the second part of its report upon an investigation into the variation of the apparent bearings of radio transmitting stations that is being carried out under the direction of Mr. R. L. Smith-Rose, of the National Physical Laboratory. Part II (Special Report No. 3, H.M. Stationery Office, 4s. 6d. net) deals with the progress of the investigation from March, 1922, to June, 1923, when observations on the longer waves of from 2,000 to 9,000 metres were discontinued at all the University and Service stations forming the original organisation. In July, 1923, the opportunity occurred for carrying out further observations at a station in higher latitudes than in England, *viz.*, at Lerwick, Shetland Islands. The discussion of the remaining observations carried out on the shorter wave-lengths down to those of 450 metres from 1922 to 1924 will follow in the publication of Part III. It is desirable again to emphasise the difference in effects which has been observed in working overland oversea: On the longer waves the situation of the transmitting and observing stations was such that all the paths of transmission less than 200 miles in length were entirely overland, which fact accounts for the abnormally large variations recorded at night for ranges of from 100 to 30 miles. For distances of less than 30 miles, the majority of the direction-finding readings are found to be accurate to within 2 deg. When the path between the transmitting and observing stations is entirely oversea, and free from any land or coastline effects, the errors in observed bearings lie within the above 2 deg. limits for all ranges up to nearly 100 miles. This accuracy is generally sufficient for most navigational purposes; also, for oversea working a 100-miles range is adequate for the ordinary application of radio direction-finding to marine navigation.

A Pneumatic Flexible Shaft-Coupling.

By J. T. TOWLSON.

THIS is a device designed to function as a driving member between such elements as a motor and a generator, more especially when the machines are not rigidly fixed on a common bedplate, and where there is an absence of "dead" alignment through the two machines. As is well known, such is the purpose of all flexible couplings, the particular requirements for these being that provision must be made for an "endwise," conjointly with a relative diametrical, movement of the two parts of the coupling. The allowance "endwise" is needed on account of the proclivity of d.c. armatures to develop an appreciable floating movement, while the diametrical allowance in the coupling provides against undue or abnormal strain, which would otherwise cause trouble, as a result of want of alignment of the two machines, *i.e.*, the motor and the generator.

The new pneumatic flexible shaft-coupling, it is claimed, possesses the requirements for a two-way movement in a convenient form. For such provision, an air-expanded tube, circular and continuous, is the main



Pneumatic Flexible Coupling.

factor. This tube, of pneumatic tire form, provides the driving medium between the motor and the generator.

Referring to the sketch, it will be seen that a space of (for example) 2½ in. is provided between the outside diameter of the inner ring and the inside diameter of the outer ring. Through this space the uninflated tube is pressed, and after it has passed into position it is inflated to the necessary pressure by the usual means and with the usual connections.

The qualities of the pneumatic tire, in which the pressure at a point is distributed throughout the whole of the tire, are here in full operation; alterations of relative position of the two parts of the coupling, as it is rotated, are freely and "sweetly" compensated for by the automatic flattening of the tube at the position of smallest space. End-wise movement has been generously provided for in the design, there being a floating ring interposed between the driver and the driven member. This ring, with its ample and positive "feather" drive, is allowed to slide freely in the outer ring of the coupling, and thus permits endwise movement of the respective armatures.

Referring to the sketches, A may be the driving shaft, and B the driven one, or *vice versa*. C is the outer ring, slotted as at H, and D is the inner ring. E is the 2½-in. space, by way of which the 4-in. tube (uninflated) is pressed into the circular space provided. F is the tube, shown inflated. G is the intermediate sliding and compensating ring. The driving power of the tube will vary as the pressure of inflation; it may be increased by corrugating the surfaces with which it is in contact. The coupling illustrated transmits 100 h.p. at 480 r.p.m.

London and Home Counties Joint Electricity Authority.

Report of Proceedings at the end of last year.

THE following is a brief *résumé* of the matters dealt with by the London and Home Counties Joint Electricity Authority on December 30th, 1925:—

Finance Committee.—It is understood that most of the schedules submitted by the London electricity companies to the London County Council for the purpose of identifying the value of the assets of the companies (which is necessary for the final settlement of the standard prices) are now being examined by the L.C.C.'s officers, assisted by Messrs. J. H. Rider and W. Cash.

The J.E.A. approves of the L.C.C.'s action in this connection.

General Purposes Committee.—The J.E.A. has agreed to the principle of remunerating its chairman.

Upon the suggestion of the Conference of Local Authorities owning Electricity Undertakings in Greater London, the J.E.A. is to consider the existing methods of valuation of electricity undertakings for assessment for rating purposes. The present system, it is claimed, inevitably leads to very serious inequalities and fluctuations in values, the effect of which is that the earning capacity of different undertakings is burdened unequally in respect of rates.

Technical Development and Works Committee.—The appointment of an advisory technical committee has been postponed until the technical reorganisation schemes for the London area have been fully considered.

The J.E.A. has received applications for special orders from (*a*) the County of London Electric Supply Co., Ltd., to supply the Parish of Merstham in the rural district of Reigate, and from (*b*) Callender's Cable and Construction Co., Ltd., to supply part of the Parish of Chessington in the rural district of Epsom; there is no authorised distributor in either area, but both are within the J.E.A.'s district. On the advice of Mr. J. H. Rider (technical adviser retained by the J.E.A.) formal objection is being made in both cases on the ground that Section 15 of the schedule of the London Order requires the J.E.A. to submit proposals to the Commissioners for the supply of areas within the district not now forming part of the area of any authorised distributor.

The application of the London Power Co., Ltd., for the Electricity Commissioners' sanction to lay new transmission mains from the Deptford power station and elsewhere is being considered by the J.E.A.'s technical adviser. No objection has been offered to the Westminster Electric Supply Corporation and the St. Marylebone Borough Council altering the system of supply to certain premises. Mr. Rider is to investigate at once the provision of bulk supplies in the western section of the J.E.A.'s area, together with the possibility of developing existing stations (where desirable) and the erection of a capital station. In this connection also Mr. Rider will take into consideration the Barnes Urban District Council's and the Kingston-upon-Thames Corporation's proposals for station extensions and bulk supplies respectively.

Committee Chairmen.—The following gentlemen will preside over the J.E.A.'s various committees during the ensuing year:—

Finance: Chairman, Mr. A. Emil Davies, L.C.C.; vice-chairman, Councillor B. J. Samels.

General Purposes: Chairman, Alderman C. R. Attlee, M.A., M.P.; vice-chairman, Mr. W. F. Marchant, L.C.C.

Technical Development and Works: Chairman, Alderman Duncan Watson, J.P., M.I.E.E.; vice-chairman, Lt.-Col. F. A. Cortez Leigh, M.Inst.C.E., M.I.M.E., M.I.E.E.

A Novel Power Scheme.—We learn from *Power* of a remarkable power scheme originating from Germany which provides for the erection of a steel tower 1,950 ft. high, to serve a double function as an electrical generator and a wireless station. As a generator it will have a capacity of 6,000 kW. Two enormous wind wheels will be provided which, it is said, will "stir" in the gentlest breeze. The cost of the tower is estimated at $1,000,000, and that of the electrical machinery at $500,000.

A 40,000-kVA Frequency Changer.—What is claimed to be the largest frequency changer ever built is approaching completion at the works of the Westinghouse Electric and Manufacturing Co., at East Pittsburg, Pa., U.S.A. It has a rating of 40,000 kVA at 300 r.p.m., 3-phase, 25 and 60 cycles. The design of the 60-cycle end of the machine incorporates an arrangement by which the stator may be shifted by means of a motor-driven rotating gear. This provision is for the purpose of adjustment of phase position, and thereby load adjustment. The machines are cooled by a closed ventilating system which includes air-washers.

Business Notes.

Commercial and Industrial Developments, Business Changes, Trade Opportunities, New Publicity Literature, Liquidations and Failures.

The "Electrical Review" Index.—The Index for the last half-yearly volume of the ELECTRICAL REVIEW (July to December) is now being printed. Copies will be forwarded post free to those requiring them for binding or for reference purposes, if they will make application to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.

Electrical Exhibitors at Birmingham.—The following is the list of electrical companies and firms who had taken space at the British Industries Fair, Birmingham (February 15th to 26th) down to the end of last week :—

Barratt & Wakefield, Ltd.
Belling & Co.
Beuttell, A. W., Ltd.
Birmingham Electric Supply Dept.
British Electric Transformer Co., Ltd.
British Electrical Repairs, Ltd.
Burnand, W. E., & Co.
Cable Accessories Co., Ltd.
Castle Fuse & Engineering Co.
Chloride Electrical Storage Co., Ltd.
Coley & Swinnerton, Ltd.
Credenda Conduits, Ltd.
Crewe, Morgan & Co.
Daulby, S. J.
Edison Swan Electric Co., Ltd.
Electric Heating & Hardware, Ltd.
English Electric Co., Ltd.
General Electric Co., Ltd.
Hewittic Electric Co., Ltd.
Higgs Motors.
Imperial Engineering Co.
Jackson Electric Stove Co., Ltd.
K.F.M. Engineering Co., Ltd.
London Electric Wire Co. and Smiths, Ltd.
McGeoch & Co., Ltd.
Millington, E. H. & Co.
M.K. Electric, Ltd.
Manda Motors, Ltd.
Nobbs, Geo., Ltd.
Parsons, C. H., Ltd.
Premier Electric Heaters, Ltd.
Reeves & Co.
R.M.P., Ltd.
Sax, Julius & Co., Ltd.
Siluminite Insulator Co., Ltd.
Sturge & Baker, Ltd.
Tucker, J. H., & Co., Ltd.
Turnock, Geo.
Young, Osmond & Young.

New Showroom.—The Richmond Electric Light and Power Co., Ltd., has recently opened a new showroom in George Street, one of the principal thoroughfares of Richmond, Surrey. The new showroom is much more accessible and attractive than the company's original premises.

The Electrical Industry.—Sir Hugo Hirst, chairman and managing director of the General Electric Co., Ltd., expressed his views on the industrial position as follows in the *Financial News* on January 1st :—"The prosperity enjoyed by the electrical industry seems to me a good index of greater activity among most industries in the country. I am hopeful that the unostentatious policy of the present Government, working for political peace abroad and industrial peace at home, may continue to be successful and strengthen the confidence which is gaining ground in all classes of society, and which is the foundation of all further development. The continuation of industrial peace will bring about the right mentality, both of employers and employed, and I am sure will restore gradually normality even in the coal, steel, and shipbuilding industries, which are to-day still suffering greatly."

Meter Approved.—The Electricity Commissioners have approved of the construction and pattern of the meter known as the Sangamo-Ediswan D.C. Type "N H" Mercury Motor A.H. Meter, rated from and including 2.5 amps. to 1,000 amps.

Aiding Registered Contractors.—The Newcastle-upon-Tyne Electric Supply Co., Ltd., is encouraging its present and prospective consumers to employ only registered contractors for their electrical work. This is done by means of two posters which are framed and hung in prominent positions in the showrooms of the company and its associated concerns. One of the posters impresses upon the reader the advantages obtained by employing registered contractors, while the other contains a list of such contractors in the company's area of supply.

For the Wireless Retail Trader. — "The Wireless Retailers' Handbook," of which we have already made brief mention, has now come to hand. *Bona-fide* wireless retailers can have copies free on application to the Wireless Retailers' Association, 70, Finsbury Pavement, London, E.C.2. Including advertisements, the pamphlet consists of 100 pages. The literary contents comprise particulars of the Association and its activities, also a number of articles and tables likely to be useful to retailers in the daily conduct of their business, on such subjects as price-cutting and the remedy, patent royalties and licences, the Shops' Act, British standard terms and definitions, table of the principal valves, &c.

Electrical Engineering in the North.—A special correspondent of the Manchester *Daily Dispatch* states that while general engineering in the area has only slightly improved, in certain sections, the outlook is certainly better. In the electrical branch order books are filling up, and, although there is not yet any marked call for extra workers, the regularity with which work required follows work completed is encouraging, and guarantees steadiness of employment.

Commercial Education. — The annual presentation of medals and prizes to the successful candidates in the Commercial Education Examinations of the London Chamber of Commerce will take place, under the presidency of the Lord Mayor, at the Mansion House on Friday, February 5th. The Duchess of Atholl, D.B.E., M.P. (Parliamentary Secretary to the Board of Education) will present the awards.

Social Events.—The annual dance of the Glasgow staff of the General Electric Co., Ltd., was held on December 28th. There was an attendance of over 300. Many original and novel ideas were introduced and Mr. G. A. Scott Walker and his committee were congratulated on the success of the function.

The St. James' Electric Rifle Club held its annual prize distribution on December 23rd, the chair being taken by Mr. F. J. Walker, the president, who welcomed Sir Alex. B. W. Kennedy, F.R.S., the chief engineer to the St. James' and Pall Mall Electric Light Co., Ltd. The prizes were distributed by Mrs. Andrews. The championship of the club was won by Mr. F. O. Andrews, who carried off the "Walker" and the "Deane" challenge cups and the rose bowl. The runner-up in the last two events was the hon. secretary, Mr. C. P. Fox.

The annual staff dance of the Sheffield Corporation Electric Supply Department was held on New Year's Eve, and was attended by a company of about 120.

American Electrical Vehicle Exports.—Figures just to hand show that 18 electrical vehicles valued at £4,768 were exported from the United States during October last as compared with only 8 (£1,001) in the preceding month and 18 (£4,885) in October, 1924.

Commercial Buildings in Demand.—MESSRS. LEOPOLD FARMER & SONS, London, report that during 1925 there was a constant demand for factory and commercial property, and in recent months that demand has considerably grown, due, in many cases, no doubt, to the progress of the Safeguarding of Industries measure, which has proved a great incentive for the acquiring of factories all over the country by British, as well as foreign firms. The increased activity in trade generally is also another important factor for the enlargement of works, and the establishment of new ones. At the present moment there are as many inquiries for factories as there have been for some years, if not more.

Lead.—Reporting on December 31st, 1925, Messrs. James Forster & Co. stated :—"Consumers have been buying fairly well lately, but not in any quantity to justify rising prices. Consumption has been about 'top notch' for months past, and cannot be expected to increase. Normal imports from Australia will, of course, follow after January, which will mean a return to about 8,000 tons per month, against 25,000 tons in October and November shipments. The course of the market greatly depends on whether the Continent recovers its absorption powers or continues to dump lead here which it has bought and cannot absorb."

To Avoid Competition in France.—Discussions have begun among the electrical manufacturing works in France with the object of reaching an agreement for the avoidance of "mutual competition" and for obtaining better selling prices.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 1st contains lists of tradesmen in London and elsewhere who hold appointments to Royalty with authority to use the Royal Arms.

Trade Announcements.—For family reasons the business of MESSRS. E. P. ALLAM & CO., of 107-109, Gray's Inn Road, London, W.C.1, has been converted into a private limited liability company, under the style of E. P. Allam & Co., Ltd. There will be no alteration in the management and staff.

MESSRS. F. GILMAN (B.S.T.), LTD., of Smethwick, have purchased the business of Messrs. G. F. Clements & Co., Regent Street, Smethwick, manufacturers of boiler scaling tools. The business of that firm will now be dealt with from the main offices of Messrs. Gilman, Grange Works, Smethwick.

The GEAR GRINDING CO., LTD., Birmingham, has established, in Milan, Italy, the Società Italiana Rettifica Ingranaggi (S.I.R.I.). The works will be equipped and operated on similar lines to those employed in the Birmingham shops.

From announcements which are prominently made in our advertisement pages this week it will be seen that STANDARD TELEPHONES & CABLES, LTD. (formerly Western Electric Co., Ltd.), has entered into an agreement with the Birmingham Small Arms Co., Ltd., whereunder the products of the former company in connection with radio broadcast receiving apparatus, will be distributed by the two companies in the future. The Birmingham Small Arms Co., Ltd., has formed a new company (B.S.A. Radio, Ltd.), to develop the sale of such apparatus, and this new company, under an agreement with Standard Telephones & Cables, Ltd., has a range of apparatus in preparation. The manufacturing and distributing organisations of the two companies will be available to manufacture and market present and future products in pursuance of a common policy.

The announcement that the B.S.A. Company has entered the wireless field is the most interesting of recent trade events. While it will be of undoubted interest to the motor and cycle trade it will, we know, be of particular interest to the wireless trade. The B.S.A. trading policy which has been so popular with the cycle and motor-cycle trades will be followed in the company's connection with the wireless industry. Details of the B.S.A. radio products will be published later, but agents who are interested in the sale of wireless apparatus should send in their names to B.S.A. Radio, Limited, Small Heath, Birmingham, so that they can be entered on the company's trade register to ensure receiving full particulars of B.S.A. radio broadcast apparatus from time to time. Mr. J. W. Bryan, the firm's publicity manager, who has been closely connected with the company's sales departments, will be in charge of all matters relating to sales of B.S.A. Radio, Ltd.

THE PHOTECTOR CO., LTD., has removed to 711-715, Fulham Road, London, S.W.6.

MAGNUM ELECTRIC APPLIANCES have just opened larger premises at Magnum Works, Upper Elmers End Road, Elmers End, Kent, in consequence of increased business.

The premises of Mr. ALAN E. DENT, Russell Street, Nelson, were damaged by water used upon an adjacent fire on January 1st; Mr. Dent is therefore temporarily occupying premises at Croasdale Buildings, Nelson. He desires to obtain a fresh stock of catalogues and lists from factors and manufacturers.

Catalogues and Lists.—THE MARCONIPHONE CO., LTD., 210-212, Tottenham Court Road, W.1.—A pair of coloured cardboard cut-outs advertising "Marconi" valves.

THE ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2.—Price List No. 2,071, dealing with the company's oil-immersed switch-fuses, and Publication No. 586, describing "Class XR" induction regulators. Both are well illustrated.

MESSRS. FRY & CO., LTD., Maskell Street Works, Rusholme Road, Manchester.—Price lists of "Efanco" cotton-covered instrument wires, and "Eiffel" inductance coils.

THE AUTOMATIC TELEPHONE MFG. CO., LTD., Milton Road, Edge Lane, Liverpool.—A set of three coloured showcards advertising the company's "Claritone" loud speakers and telephones.

MESSRS. CROMPTON & CO., LTD., Chelmsford.—List A.6, illustrating and describing the company's 3-phase induction motors of various sizes and for a number of frequencies.

THE BRITISH ELECTRICAL & MANUFACTURING CO., Clavering Place, Newcastle-upon-Tyne.—A priced and illustrated pamphlet advertising the "Orion" vacuum cleaner.

THE EDISON SWAN ELECTRIC CO., LTD., 123-5, Queen Victoria Street, E.C.4.—An illustrated and priced catalogue of lighting fittings for offices, shops, restaurants, and public illumination.

THE GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—A booklet directing the reader to the company's headquarters, giving railway, tramway, and omnibus routes.

THE GOODYEAR TYRE & RUBBER CO. (GREAT BRITAIN), LTD., Chelsea Wharf, Lots Road, S.W.10.—A booklet containing particulars of the company's transmission belting and data regarding the subject of belt drives.

THE STONEBRIDGE ELECTRICAL CO., LTD., Victoria Road, North Acton, W.3.—List No. 93, dealing with portable dynamometer precision and commercial instruments.

MESSRS. BAXTER & CAUNTER, LTD., 219, Tottenham Court Road, W.1.—A comprehensive price list of electrical materials, accessories, and appliances, including pumping sets, cables, domestic appliances, battery-charging switchboards, &c.

MESSRS. L. MCMICHAEL, LTD., Wexham Road, Slough.—An illustrated and priced pamphlet dealing with fixed condensers and grid leaks.

Calendars, Diaries, &c.—From the SUN ELECTRICAL CO., LTD., of 118-120, Charing Cross Road, London, W.C.2, we have received a set of refills slips for its desk calendar for 1926.

A Letts's "Quickref" Engineer's Handbook and Diary for 1926, containing much engineering data in tabular and other form, has been received from INTERNATIONAL COMBUSTION, LTD., of Africa House, Kingsway, W.C.2.

A wall calendar with monthly sheets for 1926 has come to hand from our contemporary the *Chemical Trade Journal*.

In accordance with their long-established custom, MESSRS. W. H. WILCOX & CO., LTD., 33, Southwark Street, London, S.E.1, have prepared a hanging Date Remembrancer with monthly sheets for the coming year.

BROOKHIRST SWITCHGEAR, LTD., is very regular in its supply of calendar cards. We have received those for the first three months of 1926. The excellent views of Chester have been replaced by pictures of the company's products.

MESSRS. DOWNES & DAVIES, 1 & 3, Stanley Street, Liverpool, have sent us a calendar upon which appears a study in colour of "My Lady Fair." Monthly date slips are provided.

From MESSRS. ROPER BROS., 5, South Anne Street, Dublin, we have received a block of daily slips for 1926 to replace those which we received last year.

MESSRS. B. S. & W. WHITELEY, LTD., of Pool Paper Mills, Pool, near Leeds, have prepared a calendar with daily slips, each bearing a literary quotation.

MESSRS. EVERSHED & VIGNOLES, LTD., Acton Lane Works, Chiswick, London, W.4, have sent us a neat calendar for 1926, each monthly sheet of which has a picture of some charming house, or village or country scene.

From MESSRS. RD. JOHNSON, CLAPHAM & MORRIS, LTD., Manchester, we have received a wall calendar, above the date slips of which is a view, taken from the air, of the company's head offices and works. Accompanying it is a pamphlet containing a well-illustrated description of the company's new warehouse building.

The calendar of the LONDON MAGNETO REPAIRING & WINDING CO., LTD., of 78, Hampstead Road, Euston, London, N.W., illustrates in colour the welcome accorded to Muriel or Daphne on her arrival by car.

An artistic wall calendar has reached us from the LANCASHIRE UNITED TRAMWAYS, LTD.

THE BRITISH EBONITE CO., LTD., of Hanwell, London, W.7, has issued a small wall calendar with two-monthly removable slips, humorously illustrated.

THE ENGLISH ELECTRIC CO., LTD., of Queen's House, Kingsway, London, W.C.2, has prepared a daily block calendar with clear red figuring.

THE S.E.A. CO., LTD., of Lichfield Street, Hanley, has circulated a wall calendar with humorous illustrations depicting "Wireless Howlers"; two months to the sheet.

MESSRS. POPE'S ELECTRIC LAMP CO., LTD., of 5, Arthur Street, New Oxford Street, London, W.C.2, have sent us a wall calendar with monthly sheets boldly figured.

A "Utility" calendar with bold-figured daily slips has been received from Mr. Cecil Ridley, 35 and 37, Dundas Mews, Middlesbrough.

A view of a ruined riverside abbey appears upon the calendar sent us by MESSRS. DORMOR & HINES, 74, Old Christchurch Road, Bournemouth. The bottom forms a pocket for letters, &c., and has monthly date sheets.

A large-scale representation of a valve, in which appears the portrait of a pretty girl, forms the calendar of the MULLARD WIRELESS SERVICE CO., LTD. There is also a block of daily slips.

MESSRS. G. S. PECKHAM & CO., of 4 & 5, New Compton Street, Charing Cross Road, London, W.C.2, have prepared a very serviceable desk reminder for the entry of engagements. One page per week gives ample daily space.

MESSRS. MCWHIRTER & SONS, LTD., Wharf Street, Cardiff, have sent us one of their 1926 calendars consisting of a picture of a re-winding job and a block of daily slips.

An artistic calendar with a separate sheet for each month has been received from MESSRS. PHILIPS LAMP, LTD., 60, Wilson Street, Finsbury Square, E.C.2.

MESSRS. W. H. SUGDEN & CO., LTD., have issued a useful calendar comprising monthly sheets with space for notes against each date.

We have received, as usual, the COUNTY OF LONDON ELECTRIC SUPPLY CO.'S telephone card. This year's picture is a coloured view of the new Barking station.

Bankruptcy Proceedings.—J. BRODIE, electrical engineer, 59, High Street, Dunfermline.—Public examination at the Sheriff Court House, Dunfermline, January 7th. Meeting of creditors at Messrs. MacBain & MacDonald's offices, Commercial Bank Buildings, High Street, Dunfermline, January 21st.

H. E. CHECKLEY, plumber and electrician, 20, West Street, Morecambe.—Trustee, Mr. J. F. Warburton, 28, Queen Street, Manchester, released September 17th.

Company Liquidations.—BELGRAVIA ELECTRICAL CO., LTD., 23, Old Queen Street, S.W.1.—A meeting of creditors was held recently at the offices of Messrs. Annan, Dexter & Co., when the chair was occupied by the liquidator of the company, Mr. W. H. Lovatt. The liquidator said that a private meeting was held in November, when a statement of affairs was submitted. Since that time the assets and liabilities had not altered to any great extent. It was also agreed at the last meeting that Mr. Marquand, one of the directors, should offer the creditors 10s. in the £ in settlement of their debts. Soon after that meeting the company was put into liquidation, and Mr. Marquand had informed the liquidator that it was now impossible for him to make the offer of 10s. Mr. Gardner, representing creditors, asked if any particulars could be given with regard to the debenture for £500. The liquidator replied that the debenture did not become valid until January, 1926, and before that date he would repudiate the validity of that debenture. The only thing remaining for the creditors now was for the assets to be distributed amongst the creditors *pro rata*. The net assets were £188, and the total liabilities were approximately £700. No resolutions were passed, and the matter therefore remains in the hands of the present liquidator.

SEXTON-BARNES, LTD., 61, Borough Road, S.E.1, engineers and electrical and radio manufacturers.—A meeting of creditors was held on December 30th, at the offices of Messrs. Poppleton, Appleby & Hawkins; the chair was occupied by Mr. W. Baker, who represented the liquidator of the company, Mr. E. H. Hawkins. Mr. Baker presented a statement of affairs which showed liabilities of £1,482, all due to unsecured creditors, and net assets of £457. The chairman said that at a private meeting held recently figures were presented but no particulars with regard to the trading of the company were given, and it was decided to form a committee to go into the affairs of the company. The Committee came to the conclusion that it was impossible for the business to be continued, and accordingly the shareholders passed the necessary resolution for liquidation, with Mr. Hawkins as liquidator. The company was registered in December, 1924, with a capital of £200, divided into 4,000 shares of 1s. each. The gross profit

from the commencement of the business down to December 11th, 1925, amounted to £310. Against that the overhead expenses were £1,354, which resulted in a total loss on trading of £991. Mr. Baker said that he hoped to be able to effect a sale of the assets, in which case the creditors might eventually receive a small dividend. No resolutions were passed, and the matter therefore remains in the hands of Mr. Hawkins as liquidator, together with the committee of inspection appointed at the previous meeting.

The following are creditors:—

	£		£
Benjamin Electric, Ltd.	97	L.C. Engineering Supplies, Ltd.	62
Burgess, Frederick	26	Noble, E. A.	53
Cobalt Magnet Steel Co., Ltd. ...	82	Ormiston, P., & Sons	30
Crofts, Ltd.	21	Palmer, J., & Sons, Ltd.	32
Corfield, Ltd.	82	Pickering, G. F.	242
Dyson & Co., Ltd.	61	Sanderson Bros. & Newbold, Ltd.	46
Bankers	30	Sankey, J., & Sons, Ltd. ...	32
Lloyd, R., & Co., Ltd.	22	Tickle, L. D.	314

LOW TEMPERATURE CARBONISATION, LTD.—A petition for the winding up of the above-named company has been presented to the High Court by the Dursley Gas Light and Coke Co., Ltd., of Dursley, Glos., creditors, and will be heard in London on January 12th.

L. WEEKES, LTD.—Winding up voluntarily. Liquidator, Mr. B. T. Crew, George Street, Luton.

PREMIER ELECTRIC WELDING CO. (CLYDE), LTD.—Winding up voluntarily. Liquidator, Mr. T. L. McLintock, 216, West George Street, Glasgow. Meeting of creditors, January 8th, at the offices of the liquidator.

Unemployment. — There was a further decrease in the number of unemployed during the week ended December 21st, the total at that date being 1,102,400, a fall of over 25,000.

Local Exhibition.—BURNLEY.—The Corporation has decided to organise an electrical exhibition from January 28th to February 6th, and during the same period electrical films will be exhibited at the Pavilion Picture House.

The German Insulator Industry.—The Berlin correspondent of the Exchange Telegraph Co. states that the business situation in the porcelain insulator industry became worse in November and December. The November figures show a decrease of employment by 20 to 25 per cent., as compared with October. Compared with the two best business months of last year, July and August, sales dropped by almost 40 per cent. Special complaints are made concerning the export trade. The total export of technical porcelain last year decreased by about 50 per cent. compared with the previous year, although it is claimed that prices brought hardly any profit.—*Financial News.*

Shop-window Lighting.—The accompanying illustration shows a good shop-window lighting installation which has recently been carried out at Villiers, Shaftesbury Avenue, W. "Siemens" shop-window reflectors, in conjunction with "Siemens" gasfilled lamps, are employed to obtain the

Siemens Shop-window Illumination.

desired effect, and the whole of the light is concentrated on the displayed models, &c., making them stand out in bold relief. The firm responsible for the work was Messrs. Edward Wolf & Co.

For Sale.—Messrs. Veryard & Yates will offer by auction on January 14th and 15th, at 31a, Camden Street, Camden Town, N.W., large quantities of ex-Government wireless, electrical, medical, and surplus stores, &c. Eastbourne Corporation Electricity Department has for disposal one 400-kW Ferranti engine and alternator. (See our advertisement pages to-day.)

Callender's in Germany. — The Callender Kabel Gesellschaft is the name of a new company which has lately been formed in Hamburg to handle the Callender cable productions in Germany.

Italian Tariff Reductions.—The *Board of Trade Journal* for December 31st contains a list of articles which are to be subject to lower rates of duty when imported into Italy from Germany, under the provisions of the recent commercial treaty between the two countries. By virtue of the treaty existing between this country and Italy, British goods will also be accorded the same treatment. The list includes small-gauge copper wires, internal combustion engines, "rotary hydraulic engines," portable steam engines, boilers and economisers, electric heaters, electromagnetic separators, electric soldering equipment, ammeters, electricity meters, recording meters, incandescent electric lamp bulbs, electric cars, ebonite, gutta-percha, &c.

A "Cosmos" Window Display.—The accompanying illustration shows a striking display which has been arranged for retailers of "Cosmos" lamps by Metro-Vick Supplies,

A "Cosmos" Lamp Display.

Ltd. The central piece is very attractive, being done in eleven colours and gold, with the lamp shade in red batik. At night it is illuminated by a concealed "Cosmos" lamp.

Unemployment in Germany.—The Berlin correspondent of *The Times* states that the official figures of unemployment in Germany during the first half of December showed a very sharp increase. The number of unemployed persons in receipt of State support was 673,315 on December 1st, and 1,057,031 on December 15th. So far, the state of trade offers no immediate prospect of an improvement, and the obvious political complications likely to arise from a continued period of widespread unemployment are giving rise to disquieting rumours that Government action similar to that taken in the winter of 1923 (which included the enforcement of a system of working short hours) is again contemplated.

German Machinery Exports to N.S.W. — The *Board of Trade Journal* states that during September last German dynamo-electric machinery to the value of £2,204 was imported into New South Wales.

United States Electrical Exports.—The total value of exports of electrical goods from the United States during October 1st was $7,567,087, a gain of more than $500,000 over the preceding month's figure, and about $700,000 in excess of the October, 1924, total. The increase is stated to be principally due to the rise in the exports of radio apparatus which were valued at $1,317,846, as compared with $769,249 in October, 1924. The other increases included a.c. generators and accessories, self-contained lighting sets, switchboard panels, fractional-h.p. motors, primary batteries, domestic appliances, wiring materials and accessories, lighting fittings, insulating materials, and ignition equipment. Among the classes which showed decreases were d.c. generators, transformers, large motors (above 200 h.p.), storage batteries, telephone equipment, and railway signalling equipment.

Proposed Japanese Amalgamation.—Negotiations are said to be in progress for amalgamating the Kabe Tramway Co. (with a capital of 1,500,000 yen), the Seto Inland Sea Orossing Electric Power Co. (capital 5,000,000 yen), the Shimane Electric Co. (capital 1,000,000 yen), and the Akana Electric Co. (capital 100,000 yen), with the Hiroshima Electric Co. (capital 30,000,000 yen). Being sister companies, it is thought to be comparatively easy to effect the amalgamation. Upon the amalgamation, the Kabe tramway will be electrified and hydro-electric and steam power stations will be erected. For this purpose, the amalgamation will increase its capital to 50,000,000 or 60,000,000 yen.

The A.E.G. in Mexico.—It is announced that the A.E.G. has formed a firm under the title of the A.E.G. Latein-Amerika Bau A.G., with a nominal capital of 50,000 marks, for business transactions in Mexico.

German Wire Syndicate.—The Berlin correspondent of the Exchange Telegraph Co. states that the German Wire Syndicate negotiations have been concluded by the accession of certain outstanding manufacturers. The syndicate has been formed for a fixed term of five years. The Siemens and Halske Co. has received a Belgian order for the construction of electric cables on the line Herbesthal-Brussels.—*Financial News.*

German Firm Secures Spanish Electrification Contract.—The Santander-Bilbao railway company has awarded a contract to a German firm for the electrification of the line from Bilbao to Las Avenas.—*Reuter's Trade Service* (Madrid).

Book Notices.—"The Colliery Manager's Pocket Book, 1926." Pp. 512+132; illustrated. Edited by J. Vincent Elsden, D.Sc. (Lond.) and Hubert Greenwell, F.S.S. London: The Colliery Guardian Co., Ltd.—The book is really a practical treatise on mining engineering dealing with the civil, mechanical and electrical branches separately and at considerable length. The part devoted to "Electricity in and about Mines" dwells chiefly on the plant and apparatus employed in mining, principally from the point of view of safety; the various rules and regulations concerned, including the I.E.E. wiring rules, are cited. A separate chapter is devoted to coal and its by-products, reviewing its origin and formation, as well as coal sampling and treatment. A review of the mining progress made during 1925 and various statistics relating to coal mines for the year 1924 add to the interest of the publication, while much general information, a diary, and cash account provision should prove useful.

"The Lubrication of Uniflow Steam Engines," Gargoyle Technical Series, No. 22 (12 pp., 6 figs.). London: The Vacuum Oil Co., Ltd.—This is a guide to the selection of lubricants for the type of engine named, having regard to its design, construction, operating conditions, &c.

"Water Resources Paper No. 45, Surface Water Supply of Canada. Atlantic Drainage (South of St. Lawrence River), New Brunswick, Nova Scotia, and Prince Edward Island. Climatic Years 1922-23 and 1923-24." Ottawa: F. A. Acland (for the Dominion Water Power and Reclamation Service).

"Memoirs of the College of Science, Kyoto Imperial University." Index of authors and contents of Vol. VIII, Series A, Vol. IX, No. 3; November, 1925.

"Japanese Journal of Physics; Transactions and Abstracts of the National Research Council of Japan." Vol. IV, No. 1. National Research Council, Department of Education, Japan.

"Preliminary Report on the Central Electric Station Industry in Canada, 1924." (Pp. 5.) Ottawa: Dominion Bureau of Statistics.—This report contains a general review of the supply industry in Canada with statistics of capacity, transmission systems, &c., and financial results.

"Science Abstracts" (A and B). Vol. XXVIII. Part 12. December 25th, 1925. London: E. & F. N. Spon, Ltd. Price 3s. each.

Quarterly *Bulletin* of the Institution of Engineers, Australia. Vol. II. No. 8. October 31st, 1925. Sydney: The Institution.

German Foreign Loan.—It is reported from Berlin that the Osram Gesellschaft is raising a 5 million dollar loan through a syndicate of Dutch, Swedish and British banks. The loan is to run for a period of 25 years at 7 per cent. interest.

The Argentine Electrical Market. — The French Commercial Attaché at Buenos Aires has been drawing attention to the Argentine market for electrical material. This, he points out, is large, although French manufacturers have not yet been able to gain much interest in it. The Germans and the North Americans dominate the position, and, in the view of the Commercial Attaché, it would be difficult to dislodge them. In order to obtain contracts from public authorities it is necessary to submit the material for the approval of the Technical Electrical Department of the Buenos Aires Municipality. In addition, the Tramways Company has its own specifications. The city of Buenos Aires is extending very rapidly every year, and there are now large districts under construction which no electric light system has yet reached. One-half of the city is to be rebuilt; the work has already commenced and will be carried out slowly, and it is evident that a very large amount of electrical material will be required. The average monthly sales of motors are estimated at between 2,500 and 3,000, of all sizes. Of this total it is calculated that between 1,200 and 1,250 go from the United States, 1,000 to 1,150 from Germany, 300 to 323 from Great Britain, 150 to 175 from Sweden, and only five from France. The United States' makers possess a great advantage through keeping stocks on the spot. The Germans are not far behind the Americans in their active search for electrical orders. To maintain stocks of machines and spare parts is of great importance, as no manufacturer is likely to equip his works with motors where such a service is absent. Although no definite regulations are laid down in connection with private installations, as a general rule concerns like banks and hotels insist upon tests similar to those laid down by the electrical department of the municipality. Although owing to the cheapness of certain sizes of German and American wires and cables direct competition is difficult, the Commercial Attaché considers that business is possible by cultivating relations with the wiring firms and maintaining stocks of wire and cable. For motors, the demand for a.c. and d.c. types is about the same, but as in Buenos Aires the use of d.c. motors for 220 V of more than 3 h.p. capacity is prohibited, a.c. types for 440 volts have a better sale. The squirrel cage design seems to be superseding the slip-ring motor.

New Indian Companies.—Among the new concerns recently formed in India in connection with the electrical engineering business are the International Electric Co., Calcutta (23, Strand Street), capital 100,000 rupees; and Seshasayer Bros., Trichinopoly, Madras, capital 100,000 rupees.

Lighting and Power Notes.

Australia.—WAGGA (N.S.W.).—The *Industrial Australian and Mining Standard* reports that at a recent meeting of the Municipal Council, the proposed agreement between the Council and the Public Works Department regarding the linking of Wagga with the Burrinjuck hydro-electricity scheme was discussed. Previously the council had given power to the mayor to sign an agreement, but as the result of the last meeting the council revoked this decision, and decided that a competent consulting electrical engineer should be engaged to report on the agreement generally.

TASMANIA.—Important amendments have been made in the Hydro-Electric Power Commission Bill (Tasmania). The primary object of the Bill is to place the control of the Hydro-Electric Department under a commission of three members. The Bill gives the Commission very wide powers regarding the development of the supply of hydro-electricity in the State, and the control of the distribution.

Bangor.—STREET LIGHTING.—With the object of facilitating the movement of traffic in the narrow High Street, Mr. Price F. White, the city electrical engineer, is carrying out a scheme of overhead lighting supplementary to the existing lighting arrangements.

Belgian Congo.—HYDRO-ELECTRIC SCHEME.—Additional information is now available with regard to the objects of the recently-formed Société Générale des Forces Hydro-Electriques de Katanga. It is proposed to construct a dam below the Lufira Falls, near Katanga, in the Belgian Congo and to establish a hydro-electric station for the supply of power to the Société de l'Union Minière. Following the completion of the plant, other falls are to be similarly utilised.

Birmingham.—PROGRESS DURING NOVEMBER.—At a recent meeting of the Electric Supply Committee continued progress during November was reported. New consumers connected totalled 1,031, this being the first time in the history of the undertaking that the additional connections have exceeded a thousand in a month. These additions represent in the aggregate 15,000 lamps and 1,900 h.p. for power supplies. The consumption of electricity for all purposes continues to be at the rate of nearly 20 per cent. above last year's figures.

ELECTRICAL DEVELOPMENT.—An important report has been issued by the Corporation Electricity Supply Committee on the development of the electricity undertaking involving an estimated expenditure of £478,000. The report states that the boiler plant is of sufficient capacity to deal with a further 10,000-kW turbo-alternator set, and in view of the growth of the demand in the area the Committee has come to the conclusion that it would be advantageous to install this extra plant forthwith so that it can be ready for service in time for next winter's load. The estimate of the cost of this additional set, together with the necessary foundations, piping, switchgear, cables, &c., is £60,000. It is recommended that the installation be proceeded with. The Committee has carefully reviewed the position with regard to the existing sub-station equipment, and the need for strengthening a number of the plants, and building and equipping other sub-stations in the area of supply, in order to give satisfactory service and meet the requirements for the next two years, as far as it is possible to gauge them, and has prepared a scheme which involves additional plant at six rotary converter sub-stations and the provision of five additional sub-stations in the Ward End, Acocks Green, Selly Oak, Bradford Street, and Granville Street districts, involving an estimated cost of £158,000. It is pointed out that £300,000, previously sanctioned, will have been expended on the distribution system by May, and to provide for further extensions of mains to the end of September next an outlay of £250,000 is necessary. A large amount of business is done with manufacturers requiring substantial power supplies from the e.h.p. mains, and to provide the necessary equipment it is estimated that £10,000 will be required during the ensuing twelve months.

Birkenhead.—NEW ELECTRICITY CHARGES.—The Corporation Electricity Committee proposes to introduce a new system of electricity charges based on the rateable value of dwellings. If it is approved by the Town Council at the January meeting the minimum rateable value assessment will be £18 per annum. Consumers will have the choice of two scales of charges (1) 5 per cent., of the rateable value of the premises, plus ¼d. per kWh for all electricity consumed; or (2) 2½ per cent., of the rateable value, plus 1d. per kWh for electricity consumed. Consumers must have installed electric fires or cookers and for a house not exceeding a rateable value of £30 the minimum installed load apart from lighting must be 2 kW, increasing according to the rateable value of the house. The existing system of charges will be continued where desired.

Bristol.—CHANGE-OVER.—The Electricity Committee has decided to proceed with the third part of the scheme for the change-over of the system of supply in the Stoke Bishop, Coombe Wingle, Westbury, Neuleaze, Upper Redland, Broad Weir and Barton districts, at a cost of £103,061 for mains, £15,550 for sub-station buildings, and £45,620 for plant.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—Statistics giving the amount of hydro-electric power generated in Canada during the past three years show that during each month of the past year approximately 10 per cent. more was generated than during the same month of the previous year, and 20 per cent. more than during the year before. The average power generated monthly during the past year was 21 million kWh. De-

velopment work at the Chute-à-Caron falls on the Saguenay River, Quebec, on which the Aluminium Corporation is spending over $100,000,000, will be completed by the end of 1926, according to an official announcement. Nearly 750,000 h.p. will be available.—*Reuter's Trade Service* (Ottawa).

Cheadle and Gatley.—LOANS SANCTIONED.—The Urban District Council has received sanction to loans of £4,026 for the Adswood and Ladybridge Road electricity scheme, £9,097 on account of expenditure on mains and services up to March 31st next, and £3,670 for electricity extensions in Styal Road.

Continental.—SWITZERLAND.—It is reported that the Officine Elettriche Ticinese, of Bodio, has been authorised to export up to the end of 1931 a maximum of 400,000 kWh per day to the Società Lombarda per Distribuzioni di Energia Elettrica and the Società Idrolettrica Piemontese Lombarda Ernesto Breda, of Milan. From the end of 1931 to the end of the concession the quantity of energy to be exported will be reduced to a maximum of 304,000 kWh per day.

SPAIN.—A new hydro-electric station has recently been completed by the Sociedad Electrica Industrial del Jucar at Franco de Lobo in the province of Albacete. The plant comprises two 1,900-h.p. turbo-generators, and two 1,600-kVA 6,600/66,000-V transformers. The company has now four power stations, representing a total of 95,600 h.p. and is supplying electricity to Madrid and to the district between Sagunto and Cartagena.

Dover.—ELECTRICITY IN BULK.—The Electricity Committee has received a report from the electrical engineer regarding an inquiry from the Deal and Walmer Gas Co. as to a bulk supply of electricity to Deal, and the town clerk is to inquire if the company is prepared to enter into a contract for a period of 30 years.

Eastbourne. — ELECTRICITY EXTENSIONS. — The Electricity Committee has before it proposals for the installation of a turbo-alternator, a boiler, pipe work, &c., and a cooling tower, at an estimated cost of £41,548; also new feeder cables, substations, transformers, &c., at a cost of £11,123. Meanwhile application is to be made for sanction to a loan of £15,000 for future extensions.

Guiseley (Yorks.).—STREET LIGHTING.—The Urban District Council has decided to enter into an agreement with the Electrical Distribution of Yorkshire, Ltd., for conversion of the local street lighting from gas to electricity.

Heckmondwike.—ELECTRICITY IN SMALL HOUSES.—The Urban District Council has received sanction to a scheme for wiring houses for electricity and for payments for this work to be spread over a number of years. The charge for electricity under this scheme will be 1d. per kWh more than for consumers who provide their own piping and appliances. The scheme is aimed especially to encourage electric lighting in small houses.

Jamaica.—HYDRO-ELECTRIC DEVELOPMENT.—According to *The Times Trade and Engineering Supplement*, a Government Commission has recommended that an expert should be employed to estimate the cost of the hydro-electric scheme which the Kingston Municipal Corporation proposes to install to the north of Kingston. The Crown Agents were recently instructed to place the order for the hydro-electric plant in England, but in view of the appointment of a Commission to go into the reconstruction of Kingston's thoroughfares, extension of the sewerage system, and construction of a dam within the corporate area, the Crown Agents were advised to defer taking action in the above direction. The Commission has further advised the Government that details of cost of a hydro-electric plant, circuits, &c., required in modern street lighting, should be obtained from a centre such as Halifax, Nova Scotia, where an up-to-date system has been installed. It would be advisable, the report states, that the most modern system should be provided for the Corporation's scheme. The Commission feels that the amount provided by the Corporation for the lighting project is insufficient, hence the recommendation for expert advice.

Japan.—ELECTRICAL DEVELOPMENT.—The Nagoya steam power station of the Toho Nenryoku K.K. has been completed. The plant includes one 35,000-kW generator, one of 1,000 kW, and four Babcock & Wilcox boilers. Another generating set is being installed.

The Shibaura works of the Tokyo Municipal Council, which were destroyed by fire are to be re-built at a cost of 2,168,000 yen. Work will commence early this year.

An official explanation of the position of the Shinanogawa power station scheme has been published. According to the report it has been decided to construct two power stations on the Shiano River instead of one as originally planned, of which, one at Senju is to be completed in about three years commencing in the fiscal year of 1927-1928.

Eastern Engineering reports that the Hiroshima Electric Co. is shortly erecting its second Eno-gawa water power station in view of the increased demand. The station will have an output of 11,000 kW and will be completed by June, 1927. The company is also building a steam power station with an output of 25,000 kW as a stand-by.

It is understood that the Kuhara Mining Co. has decided to construct water-power stations of about 100,000 kW, on the Shokawa, in Giju and Toyama Prefectures.

Kendal (Westmorland).—STORM DAMAGE.—During the storm on December 30th a Diesel engine at the electricity works was put out of action and the electric cables fused. Fire broke out at the local gasworks, and the gas mains at the County Hall burst, fire also breaking out there. The town was entirely without light.

London.—STEPNEY.—The Electricity Committee has instructed the borough electrical engineer to submit estimates for laying distributing mains in streets where they have not already been laid.

Lytham St. Annes.—ELECTRICITY SUPPLY PROGRESS.—During November 63 additional electricity consumers were connected and owing to the increased demand another transformer sub-station, costing £620, is now required. A bulk supply of electricity from Preston is promised for October next by which time an additional rotary converter will be added at the St. Annes station at a cost of £2,211.

Manchester.—LOANS SANCTIONED.—The Electricity Committee has received sanction to loans of £18,000 for buildings, and £32,000 for sub-station equipment.

Newport.—MAINS EXTENSIONS.—The Borough electrical engineer has prepared plans for the extension of mains at a total cost of £17,000.

Pwllheli. — ELECTRICITY SCHEME APPROVED. — The Town Council has decided to approve of the proposal of the Electricity Distribution of North Wales & District, Ltd., to supply electricity to the town. The transmission line has already reached the borough, and the Electricity Commissioners had threatened to dispense with the Council's consent unless it withdrew its claim for a deposit as security from the company.

Salford.—ELECTRICITY SUPPLY.—The Electricity Committee has recommended to the Corporation that application be made for sanction to a loan of £132,333, to cover the cost of mains and services in Salford and Prestwich, the erection and equipment of sub-stations, the provision of plant at Frederick Road power station, &c. The contract rates for the supply of electricity for motive power in the Urban District of Prestwich have been fixed at 5 per cent. above the contract rates in force in Salford.

Seaham Harbour.—ELECTRICITY IN BULK.—At a recent meeting of the Urban District Council a further report on the electricity scheme was considered, and it was agreed that the offer of the County of Durham Electrical Power Distribution Co. to supply power in bulk should be accepted. A Special Order has been applied for.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation a Special Order made by them authorising the St. Helens Corporation to supply electricity in part of the rural district of Whiston.

Applications have been made for Special Orders by the following authorities:—The Windsor Electrical Installation Co., Ltd., for the repeal of the New Windsor Electric Lighting Order, 1895, and part of the New Windsor (Extension) Order, 1920, for the cancellation, or amendment, of agreements between the New Windsor Corporation and the Company, and for authority to supply electricity in the borough of New Windsor, and the urban district of Eton; Mr. J. A. Purves, for the supply of electricity in the urban district of Bungay.

Stirling.—ELECTRICITY SUPPLY.—An application has been made by the War Office for a supply of electricity for Stirling Castle which is used as a barracks. According to the electrical engineer the cost of giving a supply by a feeder cable will be £980 and the probable revenue about £300. In addition to lighting, a large electric cooker may be installed. The electrical engineer is negotiating with the War Office regarding the matter.

Swansea.—WIRING OF SMALL HOUSES.—The Electricity Committee has adopted a report submitted by the borough electrical engineer (Mr. J. W. Burr) on the extension of the corporation's "free-wiring" scheme to property other than that owned by the Corporation. He proposed that the committee should extend the "free wiring" scheme to all properties having a ratable value not exceeding £20 per annum, providing that not less than ten houses are supplied from one service; that the consumers agree to pay 2d. extra per kWh for the first 50 kWh consumed per annum, for a given number of points (five), any additional points being allowed but a *pro rata* increase in the number of kWh to be paid at the higher rate to be made; ordinary meter rents to be charged; and the minimum consumption be ten kWh per point per annum.

Warwick.—POWER STATION FLOODED.—According to the daily Press, the recent heavy rainfall caused the River Avon to overflow. The Corporation power station was flooded and the electricity supply was cut off on January 2nd. The tramway service was also brought to a standstill.

Watford.—LOAN SANCTIONED.—The Electricity Committee has received sanction to a loan of £10,669 in connection with the extension of the electricity supply to Bovingdon.

Wellington (Salop).—OBJECTION TO ORDER.—The Urban District Council has decided to raise objections to the application of the local Gas Company for an Order to supply electricity in the district on the grounds that the charges stated in the company's application are considered excessive, and that the Council holds an Order for the supply of electricity and is prepared to give a supply as soon as a bulk supply is available.

Wrexham.—LOAN.—The Town Council has applied for sanction to a loan of £12,000 for mains services, distribution feeders, underground boxes, switchgear, and transformers.

Tramway and Railway Notes.

Australia.—SYDNEY (N.S.W.).—According to the *Industrial Australian and Mining Standard*, the New South Wales Government has officially announced that the section of the Sydney city railway from the Central Railway station to St. James' station will be open for traffic in June of next year. The other extensions to Circular Quay, and thence along the western side of the city, are expected to be completed within five years to synchronise with the opening of the harbour bridge. It is proposed to push ahead with the work on the western side of the city before completing a section at a point near Bridge Street to Circular Quay. A start on the latter section, which is estimated to cost £200,000, will be made in about two years, when, it is considered, this section can be completed at the same time as the other sections. When the railway is finished, there will be five stations, namely, Museum, St. James', Quay, Wynyard and City. Later it is proposed to make further extensions. The eastern suburbs train will pass through St. James' station, and thence round the city to the City station. It is also proposed that at some future period the line shall be extended from the City station to North Strathfield. The idea is to give a service to Haberfield, Drummoyne, Hunter's Hill, and Ryde districts, lying midway between the Main Western suburban line, and the North Shore line.

Birmingham.—TRAMWAY IMPROVEMENTS.—The Corporation tramways department proposes to enlarge its tramcar service by purchasing 30 additional tramcars at an estimated cost of £75,000; and to build a new depôt to accommodate 105 cars at Selly Oak at a cost of £51,000.

Continental.—ITALY.—With a view to meeting the competition of North Sea ports, an agreement has been arrived at between the Transalpine Association and the railway companies concerned in Italian-German freight traffic for the development of the line between Venice and Munich. Contracts will shortly be signed for the electrification of the whole line on the Italian side, the German section between Munich and Kufstein having already been partly electrified. Italian engineers have started the electrification of the stretch from Brenner to Bozen; this will leave only the line from Bozen to Verona and from Verona to Venice (or from Trent to Venice) unelectrified. When the whole work has been completed, the time of the journey between Venice and Munich will be considerably shortened.—*Reuter's Trade Service* (Venice).

Japan.—RAILWAY ELECTRIFICATION.—The Minobu Railway's Ichikawa-Marutaki line is to be completed in about May, 1927, and will be opened to traffic a few months after that date. The line is to be electrified. The Marutaki-Fuji line of the railway, which has already been constructed, is also being electrified, and the work will be completed by about August, 1926. For the first-named line the necessary energy will be obtained from the Hayakawa Hydro-Electric Co., but it is reported that the company is considering the establishment of its own plant by harnessing the Fukushi, Tsuncha, and Fuji rivers. The scheme for the construction of an electric railway between Maita, Yokohama and to Misaki is progressing steadily; the cost is estimated at 13,000,000 yen.

Llandudno.—GREAT ORME TRAMWAY.—The *Electric Railway and Tramway Journal* reports that the Llandudno Urban District Council has decided not to exercise its option to purchase, in 1926, the undertaking of the Great Orme Tramway Co., which was opened 26 years ago. Proposals are on foot for the electrification of the tramway.

Salford.—TRAMWAY AGREEMENTS.—The Corporation Tramways Committee has decided to enter into an agreement with the Eccles Corporation with respect to the maintenance of the overhead electrical equipment of the Eccles tramway, for a term of 14 years from March 31st last. The Committee has recommended a scheme for the interchange of traffic with the Bury Corporation so as to permit of the through-running of Salford tramcars to the Bury market place and of the Bury Corporation tramcars to the Victoria Bridge terminus of the Salford system.

United States.—CINCINNATI.—According to the *Electric Railway Journal* submission of a bond issue to extend the rapid transit subway at Cincinnati, Ohio, into the centre of the city is being considered by the Rapid Transit Commission. A tentative estimate made by the engineer in charge of construction more than a year ago placed the cost of the proposed extension at $1,500,000, but that figure now is deemed inadequate because of higher cost of material and labour. The engineer has informed the Commission that the subway will be ready for the laying of the track as far as Norwood next spring, but that the extension in Oakley cannot be made unless additional funds are provided. It was announced that as soon as the subway was ready for operation the street railway would operate 'buses as feeders for the system.

RAILWAY ELECTRIFICATION.—According to *Electric Traction*, the proposed hydro-electric development at Lake Chelan, in connection with the electrification of the Great Northern Railway, work on which will commence as soon as plans are approved by the Federal Power Commission, is expected to result eventually in the electrification of the Great Northern line through the Cascades and for 400 miles eastward. The contract for the construction of the dam and plant has already been placed with the Washington Water Power Company.

Telegraph and Telephone Notes.

Belgium.—NEW TELEGRAPH CABLES.—The orders for the new cables, to which reference was made in this column last week, have been placed to the value of some 62,500,000 fr. with the Ateliers de Constructions Electriques de Charleroi, and with the Siemens & Halske Co., of Berlin, for the amount of 27,000,000 fr.

WIRELESS FOR FISHING BOATS.—In its report for the last financial year, the Société Ostendsche Reederij states that, as a result of experiments carried out by the Compagnie Internationale T.S.F. with wireless telephone apparatus capable of receiving and transmitting messages up to a distance of nearly 100 miles, it has been decided to equip the entire fleet of fishing vessels owned by the Company with such apparatus.

Empire Communication.—RUGBY STATION.—The high-power Government radio-telegraph station at Hilmorton, near Rugby, was opened for general traffic on January 1st. Its call sign is GBR and the wave-length is 18,000 metres, control being by land line from the Central Telegraph Office in London.

New Radio Services.—MARCONI AGREEMENT.—As a result of an agreement signed between Marconi's Wireless Telegraph Co., Ltd., and the Postmaster-General, on December 31st, the Company is now licensed to conduct services with Denmark, Sweden, Finland, Russia, Portugal, Jugo-Slavia, Bulgaria, Turkey, and Greece, and with all foreign countries outside Europe, in addition to present services. The Company hopes to establish "beam" services from England to Canada and South Africa in April, and India and Australia in August.

Storm Damage.—Following snow and ice before Christmas, recent gales and flood water have dislocated overhead lines of communication all over the country. On the Continent, too, the same conditions obtain; not for many years have storms wreaked such havoc among telegraph and telephone communications in France and Western Europe. Thirty-six large French towns have been totally isolated, while at one time 350 telephone lines to Paris were not working, Brittany being particularly affected.

Radio Notes.

India.—NEW COMPANY.—There is every prospect of a company being registered in January under the Indian Companies Act for the establishment of a broadcasting service in India, says the *Morning Post*. It was in March last that the Government of India announced its willingness to issue a licence to such a company for a period of ten years, and for the first five years of its licence the company was to have a monopoly of broadcasting. So far as can be ascertained, only one application was received for the broadcasting licence, and the Government has recently modified its conditions.

Irish Free State.—FIRST BROADCASTING STATION.—The first broadcasting station in the Free State at Dublin commenced operations on January 1st. It is owned by the Government and works on a 390-metre wave-length; its call sign is 2RN and its plant was supplied by the Marconi Co.

Licences.—STEADY INCREASE.—Since the Postmaster-General's first warning in August, 1925, that listeners who do not take out licences for their receiving sets run a risk of being prosecuted, more than 150,000 additional licences have been taken out, and there have been many prosecutions. According to the *Daily Mail*, the number of licence holders has increased as follows:—August, 1,423,000; September, 1,464,500; October, 1,509,520; November, 1,574,732.

PROSECUTIONS.—Tudor Laurence, of the Royal Aircraft Establishment, Farnborough, was fined £1 on December 31st for installing and working a two-valve set without a licence, and Frederick Blay, of North Kensington, was fined 15s. at West London Police Court on the same day, when he pleaded guilty. Three listeners living in Rotherhithe were recently fined at Tower Bridge for using crystal sets without licences, A. J. Jarvis, of Stratford, E., was fined £1, with £1 1s. costs, at West Ham on January 4th, and several other cases have been before the Courts.

Salvador.—NEW STATION.—The 500-watt broadcasting station which has been built by the Government Telegraph and Telephone Division was expected to commence operations at the end of 1925, says *Commerce Reports*. Its wave-length will be between 400 and 500 metres.

Siberia.—NEW STATION.—The Westinghouse Electric and Manufacturing Co., of East Pittsburgh, Pa., U.S.A., has recently secured an order for a 20-kW broadcasting station for Vladivostock, Siberia.

Spain.—NEW STATION.—A contract has been entered into betwen the Government and the Compañia Ibérica de Telecommunicacion, of Madrid, for the erection of a broadcasting station at Málaga, the cost of which is estimated at between 50,000 and 70,000 pesetas. Although Málaga will not become a general distributing centre, the new station is expected to create a demand for radio equipment both in the adjoining provinces and in Spanish Morocco.—*Reuter's Trade Service* (Madrid).

Sweden.—NEW STATION.—According to *Commerce Reports*, during the past year over 100,000 receivers' licences have been issued, and it was expected that the figure would reach 120,000 before the close of 1925. The Royal Swedish Telegraph Administration has prepared a report on the radio situation, and has requested an appropriation of 1,050,000 crowns for the erection of a large broadcasting station to be located in the central part of Sweden. It is said that this station will broadcast on a 1,350-metre wave-length. Calculations show that approximately 2,000,000 persons live within a radius of 200 kilometres of the proposed site, and it is expected that the station will increase the number of receivers' licences issued by about 70,000.

Time Signals.—FRANCE.—Following the resolutions that were adopted at the International Time Commission at Cambridge in July, 1925, certain changes were made in the transmission of time signals from radio stations in France on January 1st. In May next another change will take place.

SPAIN.—The Radio Barcelona Co. proposes to establish a luminous time service by means of an electric lantern on one of the pylons which it has erected at Tibidabo, near Barcelona, to support the aerial recently installed for the new large station. In this way nearly all the province of Barcelona will be able to regulate its watches and clocks. The company is studying means of retransmitting the Eiffel Tower time.—*Reuter's Trade Service* (Madrid).

Transatlantic Tests.—The third annual transatlantic broadcasting tests will commence on Sunday night, January 24th. Canadian, American, Mexican, and Cuban stations will transmit from 3 to 4 a.m., G.m.t., every night throughout the week, following which British and Continental stations will transmit from 4 to 5 a.m., G.m.t.

United States.—RADIO INDUSTRY.—Mr. David Sarnoff, general manager of the Radio Corporation of America, in an address to the Boston Chamber of Commerce, said that statistics prepared by the Radio Corporation indicated that the business done by the radio industry in 1925 would aggregate approximately $350,000,000.—*Reuter's Trade Service* (Boston).

NEW STATION.—The Bound Brook station, the transmitting station of the Radio Corporation of America, was opened officially on January 1st, and, in connection therewith Daventry broadcast special greetings to America, which were picked up at Belfast (Maine) and relayed from there to all the associated American stations.

Accidents.—Following a breakdown early in December due to the aerial snapping under the weight of ice, the Daventry station of the British Broadcasting Co. has had five other mishaps, one of which was due to the interruption of power from the generators to the transmitter and another to a fault in the oscillator valve cooling-water system. The Birmingham station ceased operating for some time recently owing to a fire on the floor above the studio, while the London station has stopped transmitting for a few minutes on two occasions since Christmas. During the night of December 30th the smaller of the aerials on the Eiffel Tower, Paris, was carried away in a gale.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the "Electrical Review" in which the "Official Notice" appeared in our advertisement pages.)

Open.

Army Contracts.—Manufacturers who are not already on any War Office list of tenderers and who may wish to tender for Army requirements of cables, electrical stores, scientific instruments, &c., should apply to the Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, S.W., for Form 1, on which formal application for inclusion on the list of tenderers may be made. (See this issue.)

Australia.—MELBOURNE.—March 16th. Postmaster-General's Department. Battery-charging power board equipment.*

March 29th. State Electricity Commission. Transformers and auxiliary apparatus.*

Batley.—Installation of electric lighting at two West Ardsley branch stores of the Batley Co-operative Society, Ltd. Secretary.

Birmingham.—January 9th. Tramways Committee. 50 tramcar bodies. Forms of tender (£2) from Mr. A. Baker, general manager, Tramways Offices, Birmingham.

Blackpool.—January 23rd. Electricity Department. One 2,500-kVA phase and frequency changer. (January 1st.)

Bradford.—January 11th. Tramways Committee. Supply of electric trolley vehicles. Specifications from Mr R. H. Wilkinson, general manager, Corporation Tramways, 7, Hall Ings, Bradford.

Croydon.—January 11th. Tramways Department. 12 sets of electrical equipment for tramcars. (January 1st.)

Dewsbury.—January 23rd. Town Council. Reciprocating electrically-driven sludge pumps with motors and electrical equipment for Mitchell Laithes sewage disposal works. Specification from Mr. H. Dearden, borough engineer, Town Hall.

Dundee.—January 15th. Harbour Trust. Electric lighting installation at New Wharf. Schedules from Mr. J. Hannay Thomson, general manager and engineer.

Eastbourne.—January 9th. Electricity Department. 12 months' supply of h.p. and l.p. paper-insulated cable. January 25th. One 2,500-kW turbo-alternator, with condensing plant and pipework, one water-tube boiler and economiser, feed heaters and piping, one water-cooling tower. (January 1st.)

Egypt.—CAIRO.—January 16th. Chief Electrical Engineer, P.W.M. Three passenger lifts at the Egyptian State Telephones and Telegraphs Building, Cairo.—*Reuter's Trade Service* (Cairo).

Chief Inspecting Engineer in London, Queen Annes Chambers, S.W. Supply of miscellaneous spares for electrical material, &c.—*Reuter's Trade Service* (Cairo).

Honley (near Huddersfield).—January 11th. Electrician's work at the premises, The Bridge, of Honley Industrial Equitable Co-operative Society, Ltd. Quantities from Mr. E. Heaps, secretary, Westgate.

Ilford.—The Electricity Committee has decided to invite quotations for an additional 1,000-kW La Cour converter and switchgear and a 500-kW rotary converter.

Ilkley.—January 20th. Electricity Department. Feeder cables, distribution cables, feeder pillars, and network boxes. (January 1st.)

Liverpool.—Corporation Waterworks. Pumping plant, consisting of a high-lift, electrically-driven, verticle-spindle centrifugal pump at the Dudlow Lane pumping station. Specification (2 guineas) from Mr. J. R. Davidson, water engineer, 55, Dale Street, Liverpool.

London.—SHOREDITCH.—January 27th. Electricity Department. One 50,000-lb. water-tube boiler, with economiser, forced and induced draught, &c.; one 10,000-kW turbo-alternator, with condenser, pumps, &c. (December 25th.)

BETHNAL GREEN.—January 19th. Board of Guardians. Three Lancashire boilers for the hospital, Cambridge Road. Specifications, &c., from Mr. C. F. Jones, clerk to the Guardians, Bishops Road, Bethnal Green, E.

METROPOLITAN ASYLUMS BOARD.—January 27th. Installation of electric lighting at the Darenth Colony, Dartford (approx. number of points, 2,300).

E.C. January 30th. Marryat & Place. 113,000 5-amp., 220-V, tumbler-type electric switches. (See this issue.)

LONDON COUNTY COUNCIL.—January 25th. 4,425 tons of standard steel girder tramway track rails, fishplates and fish-bolts, and about 600 tons of conductor rails. Specifications from the Chief Engineer, Old County Hall, Spring Gardens, S.W.

Manchester.—January 12th. Tramways Committee. Steel girder tramway rails. Mr. H. Mattinson, general manager and chief engineer, 55, Piccadilly, Manchester.

New Zealand.—WELLINGTON.—March 2nd. Public Works Department. Synchronous condenser and transformers for the Arapuni electric power scheme.*

30,000-V switch and protective apparatus for Lake Coleridge electric power supply.*

March 8th. New Zealand Government Railways. Two 25-h.p. variable-speed motors, one 125-kW motor-generator set and 17 400-V, 3-pole switches.*

DUNEDIN.—February 26th. Otago Harbour Board. Motors, control gear, and cable.*

Rumania.—BUCHAREST.—February 4th. Rumanian State Railways. Porcelain insulators, sleeves, and plates.*

Sheffield.—January 18th. Electric Supply Department. Erection of stores, ambulance room, on site of Neepsend generating station, Club Mill Lane. Particulars from Mr. S. E. Fedden, general manager and engineer.

South Africa.—JOHANNESBURG.—January 21st. Municipal Council. 106 current transformers.*

February 26th. Motor-driven air compressor, with electrical equipment.*

S.A. RAILWAYS AND HARBOURS. February 25th. Electrically-operated hoists for raising, &c., heavy locomotives, electrically-driven geared winches, &c.*

CAPE TOWN.—January 27th. Electricity Department. Oil-cooled transformers.*

Thurnscoe.—January 12th. West Riding Education Committee. Electric lighting installation at new school. Specifications from Education Department, County Hall, Wakefield.

Walthamstow.—January 27th. U.D.C. Electricity Department. Two water-tube boilers, mechanical stokers, economisers and pipework, &c. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Bolton.—Education Committee. Accepted:—
Electric lighting installation at the new Devonshire Road Council Junior Mixed School.—James Morris.

Chorley.—Education Committee. Recommended:—
Electric lighting at school clinic.—Fisher & Co.

Hastings.—Electricity Committee. Recommended:—
H.p. switchboard (£460).—Ferguson, Pailin, Ltd.

Ilford.—Electricity Committee. Accepted:—
440 yd. .25 triple concentric cable (£330).—Hackbridge Cable Co., Ltd.

Tramways Committee. Recommended:—
200 tons of rails (£2,055); 200 pairs fishplates (£2,755).—Cargo Fleet Iron Co., Ltd.

India.—EASTERN BENGAL RAILWAY.—Accepted:—
Three 2-operator motor-generator electric arc-welding plants.—Alloy Welding Processes, Ltd.

Lamp Contracts.—The London and North-Eastern Railway Co. has placed contracts for the supply of train-lighting lamps with Edison Swan Electric Co., Ltd., and Metro-Vick Supplies, Ltd.

Contracts for 12 months' supply of "Mazda" electric lamps have been placed with the British Thomson-Houston Co., Ltd., by the London & N.E. Railway Co., the Dublin United Tramways, and the Aberdeen Line; the Siemens and English Electric Lamp Co., Ltd., has received a contract for the supply of vacuum and gasfilled lamps for one year from the Booth Steamship Co., Ltd.

Manchester.—Electricity Committee. Accepted:—
No. 10 boiler unit (equipped for pulverised fuel firing).—Babcock and Wilcox, Ltd.; sub-contractors: Motors, Lancashire Dynamo and Motor Co., Ltd.; fans and grit catcher, Davidson & Co., Ltd.
(The plant includes the following sections:—Boiler (130,000 lb. per hour), superheater, economiser, air heater, combustion chamber with water-cooled walls, pulverisers and driers, draught plant, grit catcher and chimney, pipework, tools, and spares.)
A.c. motors for High Street depôt.—F. & A. Parkinson, Ltd.
Two 500-kW fully-automatic rotary converters for Burnage sub-station; two ditto for Blackley sub-station.—Harland Engineering Co., Ltd.
Electrical storage battery.—Tudor Accumulator Co., Ltd.

Education Committee. Accepted:—
Electric lighting, Burnage and St. Phillip's schools.—A. E. Sudlow & Co.

Tramways Committee. Accepted:—
Special trackwork.—Edgar Allen & Co., Ltd.; Hadfields, Ltd.; and Titan Trackwork Co., Ltd.
One steam meter.—Electro Flow Meter Co.
Belt sander.—Abur Machinery Co., Ltd.
Bosch stationary potential and lighting dynamos.—John Roberts.
Span-wire brackets.—John Spencer, Ltd.
Electric welding plant.—Equipment and Engineering Co., Ltd.
One 600-V "Erico" welder.—Forest City Electric Co., Ltd.

Preston.—Electricity Committee. Accepted:—
H.p. switchgear (£4,926).—Metropolitan-Vickers Electrical Co., Ltd.
Steam piping (£1,645).—Babcock & Wilcox, Ltd.
Materials for outdoor sub-station (£236).—British Insulated Cabels, Ltd.

Sowerby Bridge.—U.D.C. Accepted:—
Electrician's work required in connection with the first batch of 20 scullery houses.—Oakley, Green & Wilson.

Sheffield.—The Electric Supply Committee has extended its contract with the British Electric Transformer Co. to include one ditto, 500-kVA, two ditto, 250-kVA, and 10 ditto, 100-kVA, at a total cost of £3,069.

Salford.—Electricity Committee. Accepted:—
Supply of the undermentioned cable:—1,000 yd. .0025 sq. in. l.p. concentric paper-insulated, lead-covered cable (£108); 500 yd. .1 sq. in. ditto ditto (£117); 1,000 yd. .2 sq. in. ditto ditto (£368); 1,000 yd. .0025 sq. in. l.p. twin ditto ditto (£97); 500 yd. .01 sq. in. l.p. 3-core ditto ditto (£50); 500 yd. .0225 sq. in. ditto ditto (£59); 1,000 yd. .06 sq. in. ditto ditto (£212); 1,000 yd. .12, .06, .12 sq. in. ditto ditto (£308); 500 yd. .25, .25, .25, .12 sq. in. ditto ditto (£356); 500 yd. e.h.p. .1 sq. in. concentric paper-insulated, lead-covered cable (£116). Total, £1,792.—Nederlandsche Kabelfabriek (Holland).

Smethwick.—Education Committee. Accepted:—
Electric lighting installation at new secondary school (£1,095).—Henry Hope & Sons, Ltd.

Watford.—Electricity Committee. Recommended:—
5,000-V turbo-alternator (£22,000).—Brush Electrical Engineering Co., Ltd.
Two boilers, superheaters, &c. (£11,000).—Vickers, Ltd.

York.—FOREIGN ELECTRICITY PLANT.—At the meeting of the City Council on Monday last, Ald. Wragge moved that the decision of the Council to purchase a 6,000-kW turbo-alternator for £19,000 from Oerlikon, Ltd., be rescinded. After considerable discussion the motion was defeated by 24 votes to 8.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers of the following:—

KRYPTOL high-resistance powder.
Imitation coal, as used in electrical fires.
BILT-RITE American electric drills. (British agent's name wanted.)
Plaster indirect lighting fittings.

Reviews.

The Principles of Sound Signalling. By MORRIS D. HART, M.Sc., D.I.C., A.M.I.E.E., and W. WHATELY SMITH, M.A., M.Sc. Pp. 140; 14 figs. London: Constable & Co., Ltd. Price 12s. 6d. net.

In this work the authors deal with the production, transmission, and reception of sound on a purely scientific basis, bringing together in a convenient form the results of experimental and analytical research, some of which have been previously published elsewhere. First discussing the efficiencies of a system under the three heads above-mentioned, they point out that under the conditions obtaining in practice it is preferable to use a "figure of merit" for the performance of the system, and show how it assists the engineer in comparing and improving the apparatus employed. Commencing with reception, they proceed to consider the appliances available for the detection and intensification of sound waves; dealing with transmission, they reprint a paper from the *Proceedings* of the Royal Society, in which experiments with the hot-wire microphone were described and fully discussed, leading to the conclusion that "one of the essentials for the efficient production of sound is the avoidance, as far as possible, of a high intensity at any point within the system." In the following chapter the influence of the humidity and temperature of the atmosphere on transmission is briefly described, after which two chapters are devoted to the conditions prevailing at the source and to the apparatus available for sound production, of which the centrifugal siren is said to meet the requirements of theory most satisfactorily. Finally the whole problem is briefly reviewed in the light of the investigations described. Five appendices deal with specific aspects of the subject. The work is suitable for the use of those engaged in research, to whom it will be of great value, going far towards placing this very difficult subject on a basis of precision and clarity.

A Practical Treatise on Fourier's Theorem and Harmonic Analysis for Physicists and Engineers. By ALBERT EAGLE, B.Sc., A.R.C.Sc. Pp. xiv + 178; figs. 25. London: Longmans, Green & Co. Price 9s. net.

This book, written primarily for physicists and engineers, constitutes an endeavour "to give a fairly complete account of the practical method of analysing any given curve or set of observations into its harmonic constituents, if it be a periodic function, and of detecting any periodic component in it if it is not a periodic function," and we think we may safely say that the author has succeeded in this. It is written within the bounds of the elements of trigonometry and the calculus and an introductory chapter is presented on imaginary quantities, and a few theorems on the integrals and sums of trigonometric expressions, in order to clinch the matter. We think the author would have been better advised to use the modern j for the symbolic operator instead of i, particularly as the latter is now the accepted symbol for current in electrical engineering theory. Chapter I deals with periodic functions in general, which for the purposes of the practical mathematician, the author divides up into what he terms (*a*) analytic or natural functions, (*b*) artificial functions, and (*c*) empirical functions; the treatment is extended to cover four special classes of periodic functions, namely, sine-harmonic, cosine-harmonic, odd-harmonic and bi-symmetric functions. Chapter II opens with the statement of Fourier's Theorem and proceeds to a simplification of it for the four special classes enumerated above, from which the names given to the special classes are evident. Some examples of applications to electrical engineering theory are given, these embracing studies of the terminal voltage of a three-phase generator, the voltage wave form of an alternator of given field form, the R.M.S. value of a periodic curve and the form factor. We should like to have seen more similar examples which would, we are convinced, have been particularly interesting and useful to the electrical designing engineer. Chapter III treats of the representation of artificial functions by Fourier's series or more briefly and colloquially of harmonic analysis. This chapter first works out seven problems on the harmonic analysis of different even and odd functions, passing on to a short treatment of the differentiation of a Fourier's series and thence to a study of five further problems in wave form analysis; finally it deals with the problem of obtaining a general formula for the Fourier constants in terms of the discontinuities of a periodic function.

Chapter IV deals with the representation of periodic analytic functions by Fourier's series, and three typical problems upon this are worked out. An example is worked through in detail dealing with the direct summation of Fourier's series. Chapter V discusses the representation of empirical functions by Fourier's series, the first part being devoted to a study of the simplest Fourier series of a curve passing through 2p points per period. The author then proceeds to consider the construction of schedules which facilitate the determination of the harmonic analysis, and three sets of representative schedules are given. A graphical method of harmonic analysis is next given, while subsequently the chapter deals with the error of harmonic analysis, the determination of the amplitude of any selected harmonic, a simple method of harmonic analysis, a new method of harmonic analysis, and finally, interpolation formulæ for periodic functions. The theory of Fourier's series is described in detail in Chapter VI which, the author points out, may be entirely neglected by those whose interest in the subject is purely practical, but we think the serious student would make a mistake in doing this. The chapter

deals with one or two theorems on the convergence of infinite series, the relation between the Fourier co-efficient and the properties of a function, the convergency of a Fourier series and proof of Fourier's theorem by direct summation of the series.

Chapter VII, which is intended for the student of physics, deals with Fourier's integral theorem, which is first worked out in detail and which is subsequently shown to hold good provided the integrals are convergent. The theorem is shown as applied to odd and even functions, and one or two examples in physics are given of its applications.

Chapter VIII indicates the procedure to be adopted for the search for periodicities in observed data which is not periodic, and a simple way of applying the method recommended in practice is given. The treatise concludes with a brief historical survey of the subject in Chapter IX. The volume can well be recommended to mathematical students and to engineers mathematically inclined, but in a future edition we should like to see more attention devoted to graphical and tabular methods which would permit the average designing electrical engineer to obtain the desired results in a minimum amount of time.

Dynamo-Electric Machinery. By ERICH HAUSMANN, Sc.D. Pp. viii + 645; figs. 447. London: Crosby Lockwood and Son. Price 21s. net.

Professor Hausmann's book supplants Sheldon's D.C. Machines and A.C. Machines, published first over 20 years ago. As students we disliked these books. The present attempt to embody in one volume of some 600 pages "The Theory, Construction and Operation of Direct and Alternating Current Machines" is a much better effort. Text books such as this, intended for use in technical educational institutions, must be considered and judged by their value to students. It is difficult to envisage any one type of student for whom the method of treatment adopted here would be considered satisfactory. For the beginner, the space given to electrical laws and facts is inadequate, extending as it does to one short chapter of 23 pages. Magnetic laws and facts set out in the next chapter receive the same scanty treatment. The sections on structural elements of a dynamo then introduce direct-current machines, but the elementary student cannot be brought up to this stage on these summaries of electrical theory; while for the more advanced man, who has a good knowledge of this groundwork, they are unnecessary in a treatise on dynamo-electric machinery. The section of the book dealing with direct-current machines comprises chapters on armatures, field magnets, armature reaction and commutation, generators and motors. The characteristics and applications of the several types are adequately discussed, but some account should surely have been included of machine testing, even if descriptions of car-lighting equipments, automobile motors and many of the rather meaningless half-tone block illustrations had perforce to be omitted. The chapters on alternating-current theory carry the reader rather rapidly from the consideration of the production of a sine-wave, e.m.f., alternating current, power, &c., to the calculation of instantaneous current values in reactive circuits, the natural frequency of damped circuits and harmonic wave analysis. The mathematical equipment of the student for whom the greater part of the book would seem to be designed is likely to be too undeveloped for a proper appreciation of the subject matter here. A simple exposition of polyphase working, the relationships between phase and line values of voltage and current, together with polyphase power measurement is reserved for inclusion in the chapter on alternators, where it is interpolated between sections on wave shape and the rating of alternators. A satisfactory chapter is devoted to transformers, which gives their theory, method of testing, modern constructional methods and circuit connections. This chapter, however, should have come after and not before two-phase and three-phase working had been explained. Alternator construction, voltage regulation and its pre-determination, with a short account of the conditions of parallel running, are contained in one chapter, while that following is deemed sufficient for the disposal of all types of alternating-current motors. Herein induction motors are accorded a fairly liberal treatment, which includes explanations of the circle diagram and its experimental determination. The final chapter of 50 pages is little more than a summary of letter-press, diagrams and photographs of dynamotors, motor-generators, balancers, boosters, rotary converters, mercury vapour and thermionic valve rectifiers. A feature to be commended here, as in other American books, is the provision at the end of every chapter of a number of appropriate numerical problems. If the answers had also been supplied, the usefulness of these questions to the student relying on his own reading would have been increased. The book contains much valuable and advanced information, but it has scarcely the arrangement or completeness of a text-book.

Volta Centenary.—An international electro-technical congress, which will be attended by electrical engineers from all countries, will be held at Como in 1927 to commemorate the first centenary of the death of Alessandro Volta, the physicist, who died at Como on March 5th, 1827. Count Alessandro Volta (1745-1827), the Italian physicist, was born at Como, and afterwards became Professor of Physics there. He made many important discoveries in electricity. He produced the first voltaic battery, and his name is commemorated in this invention.

Forthcoming Events.

Society of Engineers.—Friday, January 8th. At the Queen's Hotel, Birmingham. At 7.30 p.m. Paper on "The Research Factor in Cable Making," by Capt. P. Dunsheath.

Junior Institution of Engineers.—Friday, January 8th. At 39, Victoria Street, S.W. Paper, "Notes on Salesmanship," by Mr. A. J. Simpson.

Institution of Electrical Engineers.—Monday, January 11th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Informal meeting. Discussion on "The Electrical Installation in the Rockefeller Building, University College," to be opened by Mr. W. C. Clinton.

(North-Eastern Centre).—Monday, January 11th. At Armstrong College, Newcastle-on-Tyne. At 7 p.m. Ordinary meeting.

(North-Midland Centre).—Tuesday, January 12th. At the Hotel Metropole, King Street, Leeds. At 7 p.m. Ordinary meeting.

(Scottish Centre).—Tuesday, January 12th. At the North British Station Hotel, Edinburgh. At 7 p.m. Paper on "Electricity Supply Tariffs," by Mr. H. M. Sayers.

(South-Midland Centre).—Wednesday, January 13th. At the Grand Hotel, Birmingham. Annual dinner.

(Western Centre).—Monday, January 11th. At the Hotel Metropole, Swansea. Address by the president, Mr. R. A. Chattock, and annual dinner.

(Dundee Sub-Centre).—Thursday, January 14th. At University College, Dundee. At 7.30 p.m. Paper on "Atmospheric Electricity," by Mr. W. M. Mackay.

(Scottish Students' Section).—Friday, January 8th. At the Royal Technical College, Glasgow. At 7.30 p.m. Paper on "Earthing of Systems," by Mr. S. A. Knight.

(North-Western Centre, Students' Section).—Tuesday, January 12th. At the Milton Hall, Deansgate, Manchester. At 7.30 p.m. Paper on "Thermal Protective Devices," by Mr. E. C. Scott.

(South-Midland Students' Section).—Monday, January 11th. At the Temperance Hall, Temple Street, Birmingham. At 7 p.m. Exhibition of films.

Glasgow Corporation Electricity Department Engineering Society.—Monday, January 11th. At the Welfare Hall, St. Andrew's Cross Works. At 7.45 p.m. Paper on "Commutation," by Mr. P. Hunter.

Association of Mining Electrical Engineers (London Branch).—Tuesday, January 12th. At the Engineers' Club, Coventry Street. At 6.30 p.m. Paper on "Rescue Apparatus for Mines," including demonstration of certain apparatus, by Messrs. Siebe Gorman, Ltd.

(South Wales Branch).—Saturday, January 16th. At Cardiff. Annual dinner. Visit by the president, Mr. Theodore Stretton.

(Western District Sub-Branch).—Saturday, January 9th. At 62, Wind Street, Swansea. Paper on "Electrical Costing Applied to Collieries," by Mr. C. E. Yates.

Institution of Civil Engineers.—Wednesday, January 13th. At the Institution, Great George Street, S.W. At 6 p.m. Informal meeting. Discussion on "The Testing and Examination of Materials for Railway Construction," to be opened by Mr. F. J. Paice.

Institution of Engineers-in-Charge.—Wednesday, January 13th. At St. Bride Institute, Bride Lane, E.C. At 8 p.m. Paper on "Industrial Economics," by Mr. J. W. L. Rowe.

Institution of Engineering Inspection.—Friday, January 15th. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Paper on "The Characteristics of Electric Lamps in Relation to their Testing," by Messrs. B. P. Dudding and G. T. Winch.

Institution of Mechanical Engineers.—Friday, January 15th. At the Institution, Storey's Gate, S.W. At 7 p.m. Discussion on "Novelties at the 1925 Engineering Exhibition."

Manchester Electro-Harmonic Society.—Friday, January 15th. At the Albion Hotel, Piccadilly, Manchester. Concert.

Electrical Development Association Conferences.—Friday, January 15th. At Caxton Hall, Westminster, S.W. Lecture on "Suggestion and Auto-Suggestion in Salesmanship," by Mr. Ll. B. Atkinson.

Electrical Trades Commercial Travellers' Association.—Friday, January 15th. At E.L.M.A. Lighting Bureau, 15, Savoy Street, W.C.2. At 7 p.m. Lecture, "Demonstration of Lighting," by Mr. W. E. Bush.

Notes.

The Batti-Wallahs' Society.—Sir Hugo Hirst, Bart., will address the Batti-Wallahs at their next luncheon, which is to be held at the Hotel Cecil on January 27th.

N.A.S.E. Economic Premiums.—The two cash prizes offered by Mr. F. Gill, M.Inst.C.E., M.I.E.E., president of the National Association of Supervising Electricians, for the two best papers dealing with economic questions (ELECTRICAL REVIEW, October 9th) have been awarded as follows:—Mr. C. W. Bullock, London, first prize £10, for a paper on "Industrial Relations" (between employer and employed); Mr. E. J. Davies, Nantyglo, Mon., second prize, £5, for a paper on "Economics in the Electrical Industry."

Boiler Explosion Report.—We have received a copy of the official report of the preliminary inquiry into an explosion which occurred in a water-tube boiler at the Lots Road power house, Chelsea, on September 19th last. The boiler was made by Messrs. Babcock & Wilcox. One of the cap-retaining clamps in a header at the front of the boiler was fractured and the cap forced off. The material at the fracture is said to have had an unsound appearance, and probably was in a fatigued state. The management is recommended to replace all the original or worn clamps by others of stronger form or section.

Fatalities.—It is reported that Horace Newcombe, a chauffeur, of West Bridgford, was killed recently by an electric shock. He was using a hand lamp while repairing a car, when the bulb broke and the current passed through his body. Artificial respiration was resorted to without success.

On January 1st, Alfred Gains, a porter, was cleaning a gutter upon the roof of a building at the Sutton (Southern Railway) station when he came into contact with a 6,000-V cable and was instantly killed. At an inquest held on January 5th, a verdict of "Accidentally electrocuted" was returned.

(*Continued on page 63.*)

The Comines Power Station.

A French Central Station using Pulverised Fuel.

By THEODORE RICH.

WHEN the war was over the bulk of the French people, both masters and men, recognised that the only method by which the ravages of war could be eliminated and the five years' loss of economic production could be made good was by enterprise and hard work. Although on the morrow of the Armistice the politicians of France dealt a blow at reconstruction by enacting an eight-hour law, yet apart from the return of the Briey iron ore district, the development of business in coal, iron and general industry has been in many ways remarkable.

In anticipation that the "searching the pockets" of the late enemy would be something more than the optimistic make-believe of professional politicians, very large sums of borrowed money were spent in the devastated areas, and the financial embarrassments of the present day are to a large extent due to the non-fulfilment of such pledges; all the same, the condition of the exchange is no criterion of the relative state of the national assets. A great deal of solid work has been done in the North-East, West, and South of France that will doubtless bear good fruit in the near future.

Power Requirements.

The district within, say, 15 miles of Lille, which includes Roubaix and Tourcoing, forms the Lancashire of France as far as textile industries are concerned; the atmosphere is somewhat similar, and British millwrights have left their stamp on the design of many works in the neighbourhood. Some of those who were in khaki in 1918 and saw the ruined buildings would be astonished at the way in which many things have been put right again, although mounds of brickwork covered with weeds, where houses used to be, can still be seen in the streets of many towns.

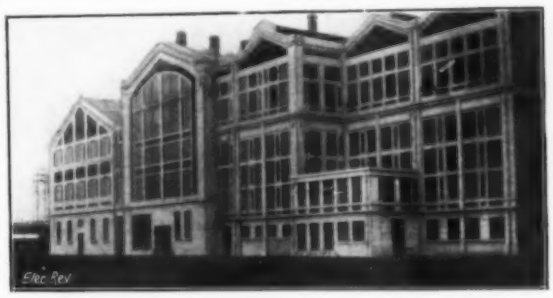


Fig. 3.—Front Elevation of Station.

Before the war a company, the Energie Electrique du Nord, supplied power, mainly in bulk, to various lighting, power, and tramway undertakings, and to some individual power consumers in a district stretching from the eastern and northern sides of Lille to the Belgian border behind Roubaix, and in some districts more to the west, from a power station of 40,000 kW at Wasquehal, near the centre of the district. This station is situated alongside a canal, and therefore the loss and inconvenience due to the use of cooling towers for the condensing water had to be contended with. In 1918 some of the plant was taken away by the Germans, and some of the remainder was wilfully damaged; it was, however, quickly put in order.

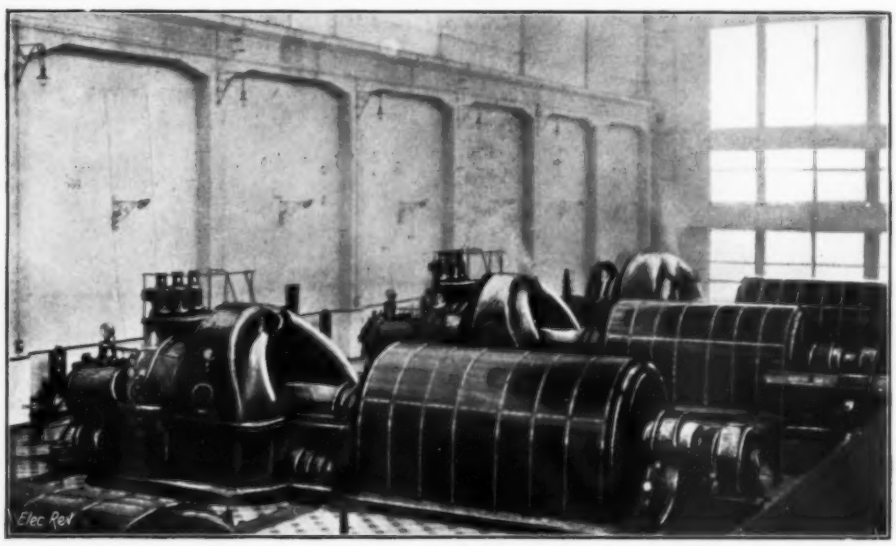


Fig. 1.—Interior of Turbine House, Comines Power Station.

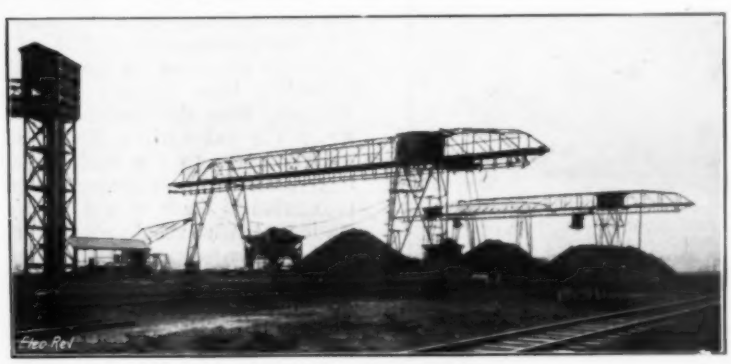


Fig. 2.—Transporters and Coal Dump.

A New Power Station.

Not long after the Armistice it was decided to put down a high-power station to meet the increasing needs of the neighbourhood, and a convenient site at Comines was decided on because of its facilities for coal transport and for condensing water; it is situated about 10 miles from Lille and about the same distance from Roubaix, and within easy distance of Halluin on one side and Armentières on the other. The whole lay-out of the power station is based upon the use of generating sets of 25,000 kW, as being an all-round useful size of plant. The station is placed alongside a navigable river, the Lys, a tributary of the Scheldt, the river at that point forming the frontier with Belgium. Coal

is obtainable in the neighbourhood by rail or by barge, and also from Belgium or Germany, and from England *via* Calais, Dunkirk, or Antwerp if required. The basin of the river Lys, when added to that of its tributary the Deule, covers several hundred square miles, and the flow is assisted by the discharge from several descending canals, the water passing being at the minimum over 5 cubic metres per second. The site, which is practically level, lies about 1 metre above flood mark. The subsoil consists of clay running into brick earth; it is not suitable for taking heavy loads, and those parts of the station which carry great weights, for instance, the boiler houses and the turbine foundations, are supported on piles 7 to 8 metres long, many of these being made of armoured concrete.

The original lay-out of the station was planned to allow of extensions, especially with a view to the convenient location of condensing-water conduits. The turbine-house plan is perpendicular to the river, space being left so that when the power demands exceed the cooling capacity of the river flow, cooling towers can be put down between the turbine house and the pump house on the bank. There are two boiler houses; in the original installation there were ten boilers in one house, each with 1,000 square metres (10,760 sq. ft.) of heating surface, five boilers sufficing for each 25,000-kW turbine unit.

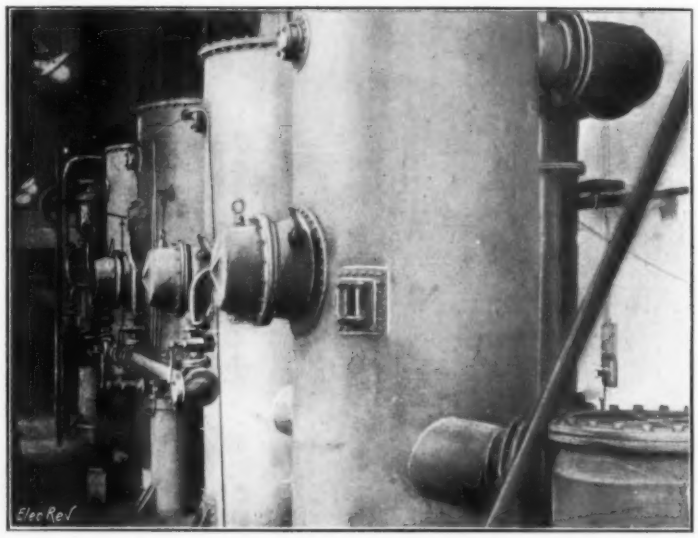


Fig. 6.—Kestner Evaporators.

In 1924 a new boiler house was built, in which two boilers have been installed up to date. The station supplies power by means of aerial lines along two main 45,000-volt trunk routes to two main disconnecting stations, one on the outskirts of Lille at La Madeleine and the other located between Roubaix and Tourcoing; in each case the final section, inside populated areas to the step-down sub-stations, consists of balanced single-core unarmoured cables. At the two main step-down stations the pressure is reduced to 10,500 volts; there are also some local aerial distributing lines at this pressure radiating from the Comines station. From the sub-stations 10,000-volt cables connect to the various bulk distributors and consumers, and connection is made to the original station at Wasquehal, so that the load can be sectionalised as desirable to suit the needs of the moment; in case of emergency such auxiliaries at Comines as are electrically driven could be supplied with current from this other station. Some details of the cable system will be given later.

Fig. 4.—Belt Conveyor in Roof between Economisers.

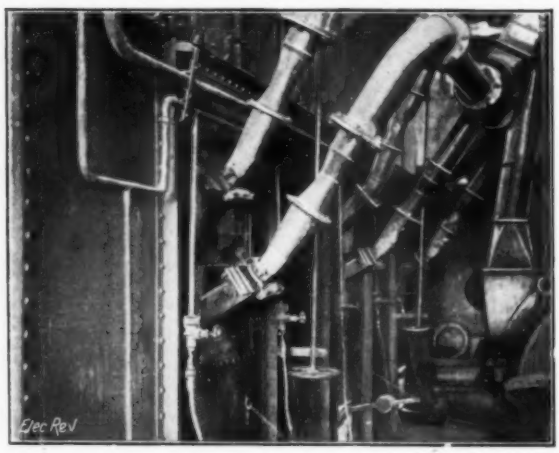


Fig. 7.—Pulverised Coal Feeders.

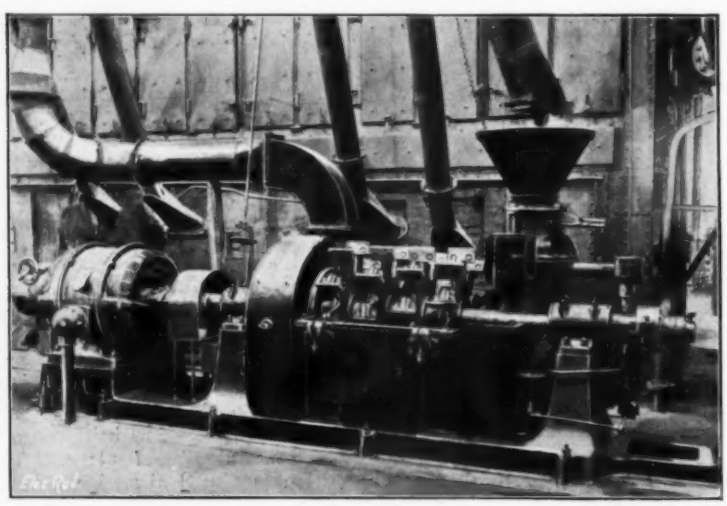


Fig. 5.—Pulveriser, Open.

The Buildings.

Armoured concrete has been used very largely in the construction of the buildings, and also for the coal bins over the boiler house. As is usual on the Continent, the buildings are roomy; there is ample space round the station, and further, owing to the facilities for the removal of ash, no space is necessary for ash dumping. The building for the transformers and switchgear takes up more floor space than the turbine house. The switchgear is of the conventional oil-tank type, the bus-

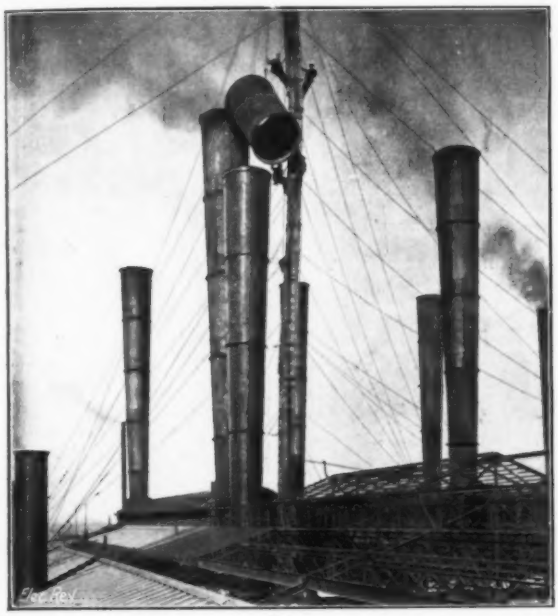


Fig. 8.—Erection of Prat Chimney in Progress.

bars and internal connections being largely of bare strip.

The station was at first equipped with three generating sets of 25,000 kW each, one of which was considered

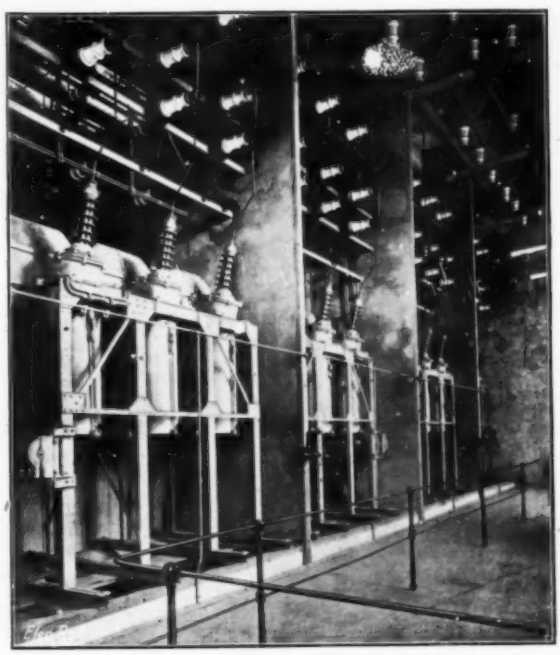


Fig. 9.—Main Oil Switches.

as reserve; the load, however, increased so rapidly that extensions were taken in hand in 1924, and a further set has been added in a lengthened turbine house, space being provided also for a fifth. At the time when the station was originally designed, some classes of electrical plant were difficult to obtain within the desired time for delivery, and this factor had some influence especially on the auxiliaries. Power stations as a rule are not beautiful, but the use of armoured concrete for the walls and the adoption of bold lines has in this case given the structure an appearance consistent with its object, namely, the supply of power; the buildings, as shown in fig. 3, despite the multiple chimneys, do not look so "tin-canny" as some other modern examples.

In order to deal more fully with certain features, the technical details will be given somewhat out of the usual sequence.

The 25,000-kW generating sets are arranged crossways in the turbine house at 13 metres (42 ft. 8 in.)

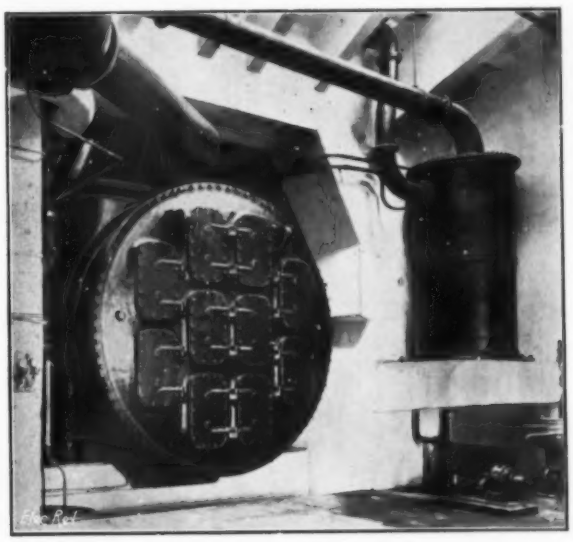


Fig. 10.—Condenser.

centres (fig. 1). They are of the Schneider-Zoelley type, running at 1,500 r.p.m. The steam end is arranged for

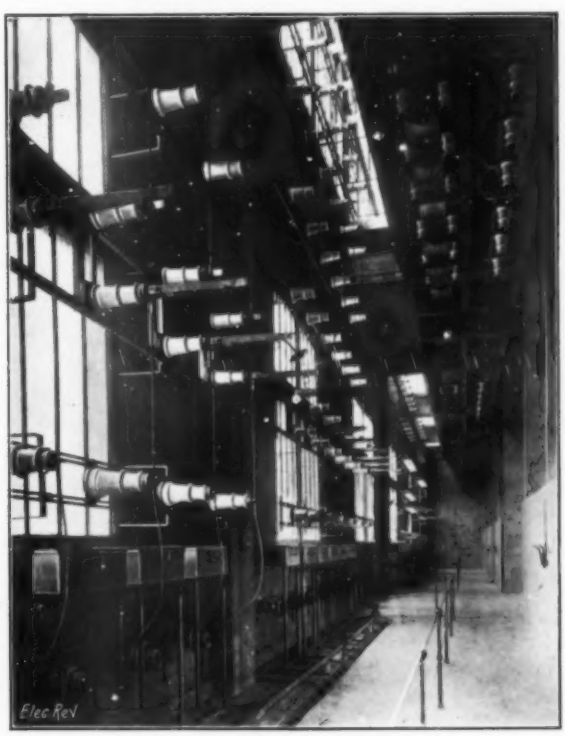


Fig. 11.—Section Links.

an effective pressure of 18 kg. per sq. cm. (about 260 lb. per sq. in.) at 350 deg. C. (660 F.) total temperature. The alternators are wound for 10,500 volts across phases; they are designed to give the normal output at a power factor of 0.8, with a rapidly falling characteristic so that they will stand a short circuit at full pres-

sure without injury. An exciter at 250 volts is coupled to each set. There is also a 160-kW asynchronous motor-generator set wound for 220 volts on the a.c. side, which acts as a reserve exciter for any of the generating sets. The cooling air for the alternators passes through water-jet filters, and is discharged under the boilers. The turbine house, which has a span of 24 metres (80 ft.), is served by an electrically-driven (220-volt d.c.) overhead traveller with a 60-ton main lift, and an auxiliary lift for dealing with weights up to 10 tons.

The condensers are of the Delas type, with their axes placed at right angles to the turbine shafts; the circulating water is delivered through sluice valves from two armoured concrete condensing pressure mains, one on each side, the discharge being into a rectangular conduit running lengthways beneath the turbine house under the axis of each condenser body. The reasons for this construction will be given later.

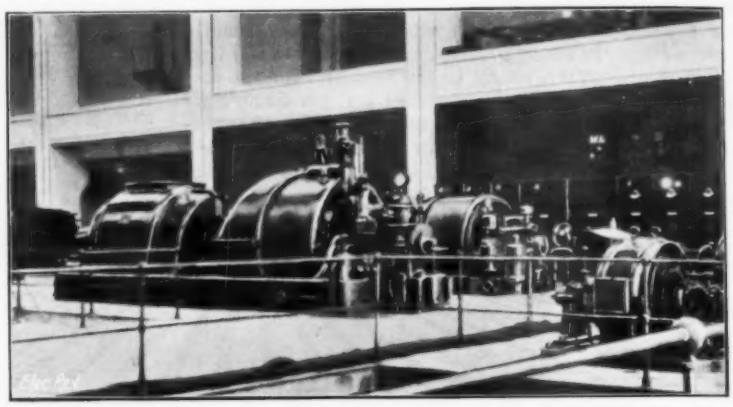


Fig. 14.—Auxiliary Turbo-Generators.

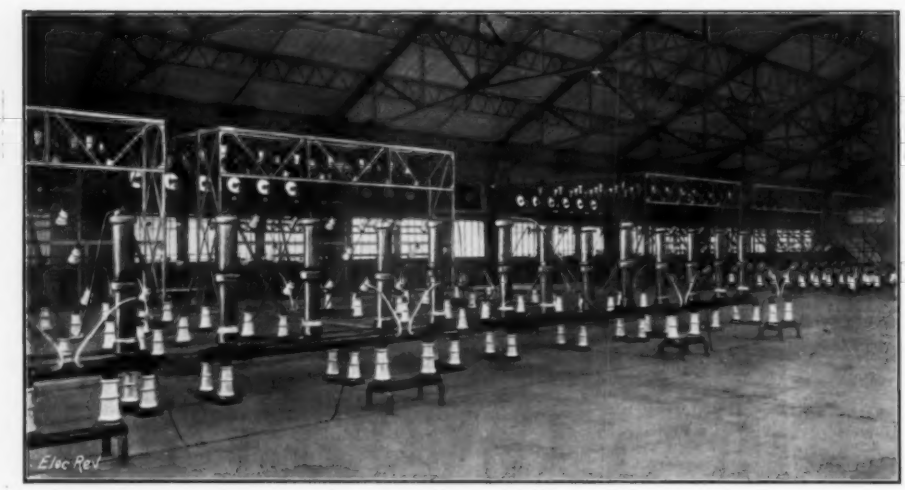


Fig. 12.—Horn Lightning Arresters in Roof.

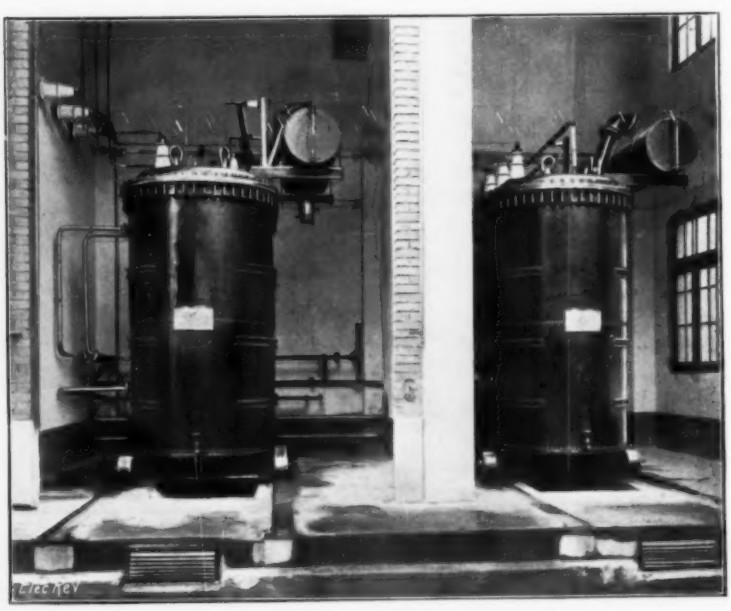


Fig. 13.—Standard Type of Transformer House.

Among the features of special interest at this station are the coal- and ash-handling arrangements, the use of powdered fuel on some of the boilers, the Kestner distillers, the circulating water system, and the arrangement of the switchgear.

The coal as a rule comes from a number of French collieries by rail or barge; each consignment is analysed, and after unloading is dumped in heaps according to analysis. It is about 15 to 16 per cent. volatile, and contains up to about 25 per cent. ash, being delivered unwashed; it has a heating value of 6,200 to 6,500 calories per kg. (ave. 11,500 B.th.u. per lb.). For the unloading, storage, and selection of the coal, three electrically-driven transformers are used with overhanging arms, 27.5 metres (90 ft.) total length, each fitted with a grab of 1.8 metres capacity (fig. 2). One of these is used for unloading barges and the other two for dealing with coal coming by rail. All three are used also for drawing coal from the dump. The transporter motors are d.c., 220 volts.

To deal with water-borne coal, a dock was constructed 85 metres long, 22 metres wide, and 3.25 metres deep; it is large enough to hold three 250-ton barges. The dock walls were made with ribbed armoured concrete slabs on the "Ravier" system, forming sheet piling, driven by means of a pile driver. The barges can be unloaded at the rate of 60 tons per hour.

The coal which comes by rail is delivered by the Nord Railway; the trucks are shunted, by means of a 120-h.p. 4-wheeled petrol-electric locomotive, into convenient positions alongside the coal dumps, three of which are arranged parallel to the dock. The coal is picked up out of the trucks by means of grabs, and any coal which remains in the corners of the trucks is shovelled or swept into pits, from which it is lifted later by the same grabs. In addition to the three transporters, there is a self-propelling electric jib crane running on railway tracks with

a radius of 8 metres (26 ft.), with a grab of 1 ton capacity, but which will lift 2½ tons as an ordinary crane when used without the grab.

Coal Mixing.

There are two types of stokers used—chain-grate and pulverisers; the different qualities of coal in stock are mixed in such proportions as experience shows to be most advantageous for each type of stoker. The coal required for consumption is lifted by the transporter grabs or by the crane grab and discharged into three self-propelled hoppers, which can be moved in a direction parallel with the coal dump sidings. Each hopper has a capacity of 40 tons, and its mouth is protected by steel grid bars placed 150 mm. (6 in.) apart to stop any large lumps; by means of a vibrating feeder, worked by a 15-h.p. enclosed motor, the discharge from each hopper can be regulated.

The hoppers discharge on to a belt conveyor 155 metres long, driven also by a 15-h.p. enclosed motor. By regulating the feed of the three hoppers on to the same belt, any desired mixture from any selected heaps can be obtained at will. The belt of the conveyor is 700 mm. wide (27½ in.), and its capacity is 80 tons per hour; on its way it passes over a Herrick integrating weighing machine. The coal, whether for the chain-grates or for the pulverisers, passes through a breaker driven by a 20-h.p. motor, which reduces it to pieces not larger than 30 mm. (1.2 in.) diameter; it is then delivered into the boot of one of two bucket elevators, which raises it to a level above the storage bins over the boiler house; one of these elevators is kept in reserve. The elevator works in a lattice-work tower (fig. 2), and delivers the coal on to a horizontal belt, with a capacity of 45 tons an hour; by means of a throw-off gear, which can be seen in fig. 4, the coal is delivered into any bin desired. The economisers can be seen to the right and left in the same illustration.

The transporters, the jib crane, and the crushers were supplied by the Société des Appareils de Levage, of Paris, and the belt conveyors, portable hoppers, and elevators by the Société des Transporteurs Mécaniques.

Ash Discharge.

The disposal of ash is a much more difficult matter than appears at first sight; ash is nasty stuff to deal with, it gets into bearings, when hot it tends to distort metal buckets or conveyor parts into all sorts of shapes, and at times it is corrosive. Under some conditions it is a great question how far elaborate ash-handling gear will pay for itself after allowing for maintenance.

At Comines, as at some other French power stations, the simplest appliances are used. The ashes from the chain-grate stokers fall into hoppers, and are emptied into small tip trucks on 60-cm. (2-ft.) gauge rails; the trucks are made up into trains and are hauled by an accumulator locomotive into a quenching shed, where water is turned on to jets on the top and sides of the trucks, actuated by an electrically-driven pump, and effectually cools the trucks and quenches the contents. The train is then hauled on to the wharf, where the ashes are tipped into barges; they are sold to builders and contractors for blockmaking, path-filling, &c., by the barge load at 3 fr. a ton, the cost of ash removal from boiler shoots to barges being about 50 centimes a ton. The ash dust which comes down from the pulveriser furnaces falls through a water-cooled outlet into a trough which is sluiced out from time to time. The amount of dust that comes down is compartively small, and the balance must of necessity go into the atmosphere in the form of very fine powder; as compared with sticky smoke, however, it is relatively unobjectionable.

(To be concluded.)

One-Man Car Report.—According to the *Electric Railway Journal* the report of the Railroad Commission on a one-man car accident on the lines of the Milwaukee Electric Railway and Light Co., showed that the number of accidents on one-man cars in Milwaukee was less than on two-man cars. The Commission found that the injuries sustained by the passenger in the case in question were due largely to a panic among the passengers.

Notes.

(Continued from page 58).

Appointments Vacant.—Linesman (77s. 5d.), for the Wolverhampton Corporation electricity department. Temporary overhead line assistant for the Worcester City Electricity Works. Meter reader and fixer for the Borough of Hornsey Electricity Department. Assistant clerk (£149) for the Beckenham U.D.C. Electricity Department. (See our advertisement pages to-day.)

The Engineer and Civilisation.—In his presidential address to the American Society of Mechanical Engineers, last month, Prof. W. F. Durand, of Stanford University, traced the history of the engineer from the skilled arrow-head maker of the stone age up to his successor of to-day, and discussed the place of the engineer and of engineering societies in the fabric of civilisation. He concluded:—

To sum up the whole matter, the engineer, either as an individual or as a collective type, is simply a link in the chain of human progress—a chain the links of which, in one form or another, run back into a past removed from our own time by tens of thousands of years, to go to no higher figures. With the trend of human progress as it now is, he seems, moreover, to be a very necessary link. He has taken upon himself the peculiar function of developing and translating into use for the needs of civilisation the constructive materials of the earth and the inorganic energies of nature, and in connection with the exercise of such function he has acquired peculiar and weighty duties and responsibilities.

There are naturally the duties of self-development and improvement, both individually and collectively, as organisations such as our own. This is the duty so well inculcated by the scriptural parable of the talents. Likewise there are the duties of friendship and of co-operation for the realisation of larger ends, and, again, both individually and collectively, as organisations.

And then it is peculiarly the duty of the engineer to see that, so far as in him may lie, these stores of nature, of which he is the custodian, are used frugally, with due regard to their limited supply, and having in mind the needs of future generations. Again, it is his duty to leave behind him some definite increment to that great store of knowledge through which we are able to enter into partnership with nature, and only by means of which we may hope more effectively to align ourselves with her laws and thus maintain an ever-ascending gradient of human progress.

Again we must, individually as we may, and collectively with definite purpose, endeavour to co-operate helpfully with agencies charged with the training of recruits for our ranks, to the end that there may be a continued and adequate supply to the younger strata in our guild, whence we may hopefully look for leadership and guidance in the future.

And, finally, since in the exercise of his functions as an engineer he must of necessity develop and employ habits of mind and methods of study which may be usefully employed in dealing with problems as they arise in all activities in life, therefore should the engineer stand ready to serve, not only in his chosen sphere, but wherever and whenever his habit of mind, his training and his experience may enable him to contribute a helpful element in this great co-operative enterprise which we call civilisation.

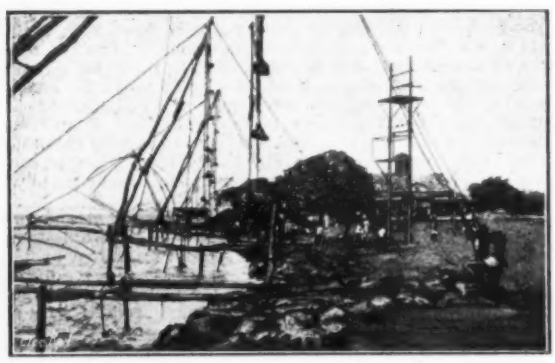
An All-Electric Experiment.—Subsequent to the publication of the article under the above heading in our issue of last week, we have been informed that the Woodlands Housing Society, Ltd., is a public utility society registered under the Industrial and Provident Societies Act, and is at the same time a subsidiary undertaking of the Bournville Village Trust for the development of a portion of the Bournville Estate. The estimate which appeared in the ELECTRICAL REVIEW of July 24th last, to the effect that by putting in only one ordinary fire grate a saving of twenty pounds would be made, has proved a very close one, and is confirmed by final costs. In the case of the "all-electric" house the saving is said to be approximately sixty pounds. It is estimated that in the case of the one-coal-fire house the weekly consumption for lighting, for a family of 5-6 persons, will be 3 kWh, for irons, &c., 3 kWh, and for cooking all food, 35.5 kWh. It is interesting to learn that from actual tests taken in all parts of the country the following figures of total consumption per annum have been estimated:—In the case of the all-electric house, 5,350 kWh, and in that of the one-coal-fire house, 4,166 kWh. Over nine hundred people visited the house during the demonstration week.

Legal.—LLANDUDNO COUNCIL *v.* LLANDUDNO AND COLWYN BAY ELECTRIC RAILWAY, LTD.—The Council recently instituted proceedings against the company for its alleged failure to keep its permanent way in a proper state of repair. The case was due to come before the Llandudno Petty Sessions on December 21st, but upon that date counsel for both parties announced that they had come to an agreement and the summons was therefore adjourned *sine die*.

Fire Offices and the I.E.E. Wiring Rules.—The secretary of the Fire Offices' Committee, London, informs us that the Offices associatoed with the Committee, numbering over 90, have given their formal approval to the 1924 Edition of the Regulations of the Institution of Electrical Engineers for the

Electrical Equipment of Buildings, and adopted the Regulations as standard practice. A letter to this effect has been circulated amongst electricity supply undertakers, consulting and installing engineers and contractors, and architects, together with a list of the companies concerned.

Ancient and Modern Methods.—The accompanying picture, received from a correspondent, illustrates an interesting juxtaposition of the old and the new which has recently been brought about in British Cochin by the installation of a town lighting and power scheme. Technically, the scheme calls for no comment, and a very brief description of the equipment will suffice. The engines are Vickers-Petter verticals driving by ropes Crompton alternators—3-phase, 2,200 volts, 50 cycles. The high-pressure transmission is by overhead mains to pole-type transformers, from which distribution is effected on the 4-wire system, high-pressure and low-pressure mains being carried on the same poles wherever possible. The illustration shows, side by side, working products of the twentieth century B.C. and the twentieth century A.D. The peculiar type of



A Contrast Between Old and New Industries.

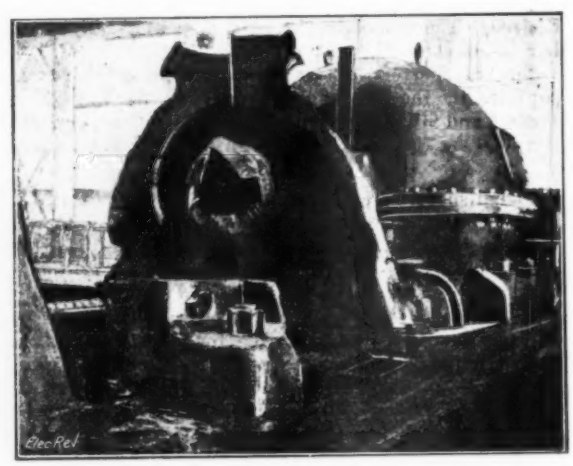
fishing-gear is essentially Chinese, and in India is found only on the Malabar Coast. Our correspondent has no information regarding the time or manner of its introduction into India. The electrification scheme has been carried out by the Crompton Engineering Company (Madras), Limited, which is also the licensee.

Radio Uses of Piezo-Electric Crystals.—Piezo-electricity is having some remarkable new applications. Certain crystals undergo a slight expansion or contraction when an electrical pressure is applied to them and, *vice versa*, produce a slight voltage when compressed or pulled. A piece of quartz crystal 1 or 2 in. long has a high natural frequency of the same order as the frequencies of currents used in radio communication; the frequency of vibration of the piece of quartz is extraordinarily constant and is very useful as a radio standard. In association with a small electron tube it acts as an oscillator or a generator of current, the frequency of which is that of the mechanical vibration of the piece of crystal. As the frequency thus produced is accompanied by numerous harmonics, the crystal is a standard giving several radio-frequencies; it is thus a remarkable supplement to the wave meters which have hitherto been used as standards of radio-frequency.

A study just completed by the American Bureau of Standards indicates that such a quartz oscillator has many valuable applications in radio work. Means of producing audio- as well as radio-frequencies were worked out. The crystals can be used to control or determine the frequency of a transmitting station and to hold it strictly constant, which will mean a great advance in radio-transmission technique. The crystals are also useful in accurate setting of receiving apparatus and for controlling the frequency of radio-frequency generators used in laboratory measurement work. The value of these various applications is particularly great at the frequencies above 2,000 kilocycles which are now rapidly coming into use. A preliminary paper on this work has been prepared and will appear in the *Proceedings* of the Institute of Radio Engineers. Part of the work resulted in the design of an outfit for use by the U.S. Department of Commerce radio inspectors and adapted to the rapid and accurate standardisation of frequency meters. It consists of two simple instruments, both being operated by dry batteries. Copies of specifications for "Portable Piezo Oscillator, Type N," and for "Portable Auxiliary Generator, Type O," together with directions for the use of the two instruments (letter circular 183), may be obtained upon application to the Bureau of Standards, Washington, D.C., by persons having actual use for them.

The Effect of Altitude on Electrical Installations.—In a recent issue of *Elektrotechnik und Maschinenbau*, Herr A. Lubowsky, of the Allgemeine Elektricitats Gesellschaft, Berlin, deals with the effect of altitude on electrical installations. Standard electrical engineering practice which is based on the conditions obtaining at average altitudes, may fail to give good results in very hilly countries owing to the reduction in the density of the air, its heat conductivity, the proportion of oxygen, &c. In the case of electrical machinery, as a result of the reduced air density, the efficiency of cooling diminishes. M. Lubowsky points out that, whereas German standard practice may be adopted for altitudes up to 3,280 ft., American and British regulations provide for a reduction in the nominal efficiency of a machine used at high altitudes, which for heavily-loaded machines is reckoned at 1 per cent. for each 328 ft. above 3,280 ft. The same rule applies to transformers, but in this case the normal output may be maintained by increasing the size of the oil receptacle. M. Lubowsky states that altitude has a negligible effect on the dielectric strength of materials utilised in high-pressure apparatus. This does not, however, apply to discharge pressures in the air which are reduced in proportion to the decrease in air density. It is agreed, however, that the normal strength of high-pressure apparatus decreases with an increase in altitude in the same proportion as the nominal power of a machine. In high-pressure transmission lines the section of the conductors should be such that no corona effect is produced. The working pressure should be reduced 1 per cent. for each 328 ft. increase in altitude, and thus a 100,000-V line transmitting at sea level would be only suitable for 50,000 volts at an altitude of 16,400 ft. At such an altitude the section of the conductors to transmit at 100,000 volts would require to be that of a 200,000-volt line at sea level. As regards cables, the effect of altitude is considered to be negligible. For starting gear and regulating devices other considerations than altitude have to be taken into consideration. The effective head of hydraulic turbines decreases as the altitude becomes higher; for a barometric pressure of 760 mm. the practical suction head is 6 metres, and for a pressure of 520 mm. (which corresponds to an altitude of 16,400 ft.), the available head is only 2.8 metres. With internal-combustion engines any diminution in air density owing to altitude results in less oxygen being drawn into the engine, resulting in a reduction of the power development of about 1 per cent. for each 328 ft. of altitude; at the same time fuel consumption shows an increase of from 0.5 to 1.2 per cent.

The Rand Turbine Failure.—The accompanying illustration shows the wrecked alternator after the breakdown at the Vereeniging power station of the Victoria Falls and Transvaal Power Co. on December 8th last (ELECTRICAL REVIEW, December 11th and 18th). The shaft at the point of fracture is about a foot thick. In an official statement by Mr. Bernard Price, chief engineer to the company, he said that the machine



The Wreck of a 10,000-kW Alternator.

broke its shaft, which allowed the rotating part to foul the fixed portion; this immediately burst the frame of the machine. A very rough estimate of the total cost of the damage to the machines, buildings, &c., was put at £50,000. The illustration is reproduced from the *Rand Daily Mail*.

Radio Direction-finding Aircraft.—The aeroplane flying on the experimental night service which Imperial Airways will inaugurate on January 15th will be fitted with a form of wireless compass which will direct the pilot towards his destination. According to the *Morning Post* the pilot will listen for signals in his head telephones which will vary in strength according to how much the machine departs from its true course. In order to use this particular method of direction finding, the aeroplane is being fitted with coils placed between the fabric of the wings. While the machine is on its way from Paris to Croydon receiving apparatus working in conjunction with the wing coils will pick up a reiterated signal from the Croydon wireless station. It is claimed that this will be the first time that this method of direction finding has been employed on a regular air service. Besides the wireless compass, pilots flying machines on the night service will be aided by ten illuminated points on the route.

Mysterious Noise at a Power Station.—A noise, described as resembling a "gentle fog-horn," has annoyed the residents in the vicinity of the new power station of the Hastings Corporation for some time, and has defied identification. Prof. A. M. Low has photographed the sound-waves with a Low-Hilger audiometer, and finds that the main audio-frequency wave is acting as a carrier for other waves, indicating that

there are several different sources of vibration at work. The noise appears to emanate from the boilers, but is also ascribed to vibrating machinery; whilst it can be heard two miles away, it is inaudible at places within half a mile of the power station.

Swedish Water-Power Development.—In the course of an article upon this subject in the December *Swedish Export* (the organ of the General Export Association of Sweden) it is stated that Sweden's potential water resources are about 8.8 million h.p. The Swedish waterfalls have been utilised to the extent of 1.4 million h.p. for industrial production on a large scale in districts where other natural resources are available. About three-quarters of the water power is situated in Norrland; this is undoubtedly a drawback in view of the sparseness of the population and the comparatively severe climate of that region. The annual production of hydro-electric energy in Sweden is estimated at 3,200 million kWh, or 500 kWh per head of the population.

Quick Repair Work.—A large rotor, weighing 30 tons, of a turbo-generator belonging to the London Electric Supply Corporation, Ltd., was shipped on November 12th by river and thence by rail to the Preston works of the English Electric Co. for repair. The rotor was completely dismantled, the copper re-annealed and the rotor re-wound, tested, and returned to the generating station in London in less than five weeks from the day it was dispatched. The English Electric Co. is to be congratulated on carrying out this difficult repair on a rotor which was not of its make, the actual time taken at the works being 22 days. When one considers the size of this piece of plant and the extreme difficulty of taking it apart, re-annealing the copper, and carrying out the necessary repairs, the company's feat may be counted a wonderful performance, and it shows what can be done in this country in spite of what one hears to the contrary. The railway companies also distinguished themselves in dealing with the transport of the plant so promptly, especially in view of the difficulty of procuring special trucks large enough for such a rotor, at a time when the railways were engaged in coping with their extra holiday traffic, to say nothing of the loading and unloading and barging of such a heavy piece of machinery on the River Thames.

Institution Notes.

Institution of Electrical Engineers.—EXTENSION OF ACTIVITIES OF THE WIRELESS SECTION.—The Committee of the Wireless Section of the Institution has further considered the proposal to form a new Institute of Wireless Engineers, and is definitely of the opinion that the interests of qualified professional wireless engineers are best served by the Institution of Electrical Engineers. The formation of a new Institute, it feels confident, is unnecessary, and will not be supported by representative and qualified professional wireless engineers.

Engineers with adequate wireless qualifications can become Corporate Members, and other wireless engineers not reaching that standard are eligible as graduates and, as such, can attend all meetings of the Wireless Section as well as those of the Institution. With a view to improving and extending the activities of the Wireless Section, the following recommendations have been approved by the Council:—

While it is essential that the standard of qualifications for membership of the Institution should be maintained, more opportunity is to be afforded to the physicist engaged in wireless work to become a member of the Institution. Applications for membership of the Institution based upon the usual general scientific training and wireless professional qualifications are to be referred to a Wireless Section Membership Sub-Committee, which will guide the Membership Committee of the Council. The qualifications for membership of the Wireless Section are to remain as at present. The Wireless Section Committee is to get into direct touch with the Local Centre Committees and ascertain the possibility of:—(*a*) Starting local wireless sections; (*b*) stimulating efforts to produce local wireless papers and lectures at local centres. Each local Wireless Section, when properly constituted, is to be entitled to nominate one member to the Wireless Section Committee. A local Wireless Section is to consist of at least 15 members, who must already be members of the main Wireless Section. Wireless papers and discussions, in addition to appearing in the *Journal* of the Institution, are to be issued separately in the form of "Proceedings of the Wireless Section." The chairman of the Wireless Committee is to be an ex-officio member of Council, in the same way as are the chairmen of Local Centres, as soon as the necessary alterations to the by-laws can be made; in the meantime he will be invited to attend all meetings of the Council.

A.M.I.E.E. EXAMINATION.—The next examination will be held on April 15th, 16th, and 17th, 1926. Candidates must be either Students or Graduates of the Institution, or have lodged with the Secretary a duly completed form "E" for election as Associate Member. Entry forms for the examination, which must be completed and returned by February 1st, and particulars regarding election to membership of the Institution, may be had on application to the Secretary, the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2.

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—On Monday, January 18th, there will be an open meeting at the University of Liverpool, at 7.30 p.m., when the Faraday Lecture on "Illumination and Light" will be delivered by Mr. A. P. Trotter, M.I.E.E., with lantern slides and experiments. The public will be admitted, tickets being obtainable from the hon. secretary. Members of the Institution should apply for tickets, as admission will be by ticket only.

SOUTH MIDLAND CENTRE.—The annual dinner, postponed from November 27th, will be held on Wednesday next, at the Grand Hotel, Birmingham. There is a long list of speakers, and during the evening a special presentation to the president of the Institution, Mr. R. A. Chattock, will be made by the chairman, Mr. F. J. Moffett.

The programme for the second half of the session includes the following meetings and papers:—

January 27th.—"The Power Losses in Magnetic Sheet Material at High Flux Densities," by Mr. C. E. Webb.

February 12th.—Joint Meeting. Discussion on "Road Transport and its possible Developments." Speaker for "Electricals": Mr. C. O. Silvers.

February 17th.—"The Electrification of the Paris-Orleans Railway," by M. Parodi, Chief Electrical Engineer.

March 10th.—"Electro-Farming, or The Applications of Electricity to Agriculture." Kinematograph by Mr. R. Borlase Matthews.

March 31st.—"Power Factor and Tariff," by Mr. E. V. Clark. "Power Factor Improvement," by Mr. E. W. Dorey.

Radio Society of Great Britain.—OFFICERS.—The 12th annual general meeting of the Society was held on December 16th and the following office holders were elected for 1926:—*President*: Sir Oliver Lodge. *Acting Vice-President*: Brig.-Gen. Sir H. C. L. Holden. *Hon. Treasurer*: Prof. Ernest Wilson. *Hon. Secretary*: Maurice Child. *Members of Council*: O. F. Brown, Capt. Ian Fraser, O. W. Nicholson, J. H. Reeves, Earl Russell, Major T. Vincent-Smith, Dr. R. L. Smith Rose, and H. Bevan Swift.

A Wireless Institution in Ireland.—It is proposed to form, at an early date, an Irish Centre of the Institute of Wireless Technology, with the objects of promoting the general advancement of radio technology, and procuring the recognition of the status of the Institute by the Government, by public and local authorities, and other bodies in the country.

Junior Institution of Engineers.—At a meeting held on January 1st, six films were shown illustrating some of the work carried out at the River Don Works, Sheffield, of Messrs. Vickers, Ltd. The information imparted by these films as to the methods of production in a big steelworks proved of great interest to a large audience.

Diesel Engine Users' Association.—ELECTION OF OFFICERS.—Mr. E. W. Johnston (King's College Hospital) has been elected president of the Association for the year commencing January 1st, 1926. Messrs. F. A. Greene, M.I.E.E., and C. F. Mounsdon, A.M.I.E.E., have been elected to fill the vacancies on the General Committee, and Messrs. Percy Still, M.I.E.E., and Geoffrey Porter have been re-elected joint honorary secretaries.

At the December meeting the secretaries' annual statement was presented, concerning the progress made in the work of the Association, the increased interest in which was evidenced by the large number of publications which were sold to non-members during the year, this item amounting to £160. Towards the end of the year the final specifications for heavy-oil engines for electrical purposes were issued by the British Engineering Standards Association, on a committee of which the Diesel Engine Users' Association was represented, as well as the Incorporated Municipal Electrical Association.

Our Personal Column.

(Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements).

New Year Honours. — In the New Year Honours List there is less than there has been for a long while to interest the electrical profession and industry. Baron D'Abernon, H.M. Ambassador in Berlin since 1920, who becomes a viscount, is chairman of the Contraflo Engineering Co., Ltd., and a director of Parsons' Foreign Patents Co., Ltd. We congratulate Prof. T. Hudson Beare, F.R.S.E., M.Inst.C.E., M.I.M.E., &c., Professor of Engineering and Dean of the Faculty of Science at Edinburgh University, upon receiving the well-merited honour of knighthood.

As we reported some time ago, the successor to the late Sir Adam Beck in the post of chairman of the Hydro-Electric Power Commission of Ontario is Mr. C. A. MAGRATH, whose portrait accompanies this note. Mr. Magrath was born in Ontario in 1860. He adopted the profession of surveyor, and in this capacity was engaged in surveying land in the North-West. He attained the standing of Dominion Topographical Surveyor—the highest rank which can be reached by Dominion surveyors. For a number of years he was associated with Sir Alexander T. Galt and his son, who carried out a considerable amount of development work in Alberta, constructing railways, mining coal, and executing irrigation schemes. In all these enterprises Mr. Magrath played an important part, and in 1891, upon the incorporation of Lethbridge, he was unanimously acclaimed the first mayor. For several years he was a member of the Territorial Assembly of the North-West Territories, and in 1908 he became a member of the Dominion

House of Commons. He represented that body at the Coronation of the present King. Upon the conclusion of the Boundary Waters Treaty between Great Britain and the United States in 1911, Mr. Magrath was appointed a member of the International Joint Commission, and in 1914 he was appointed Canadian chairman of the Commission, a post which he held up to the time of his appointment as chairman of the Hydro-

Mr. Charles A. Magrath,
Chairman of the Hydro-Electric Power Commission of Ontario.

Electric Power Commission of Ontario. During the war he acted as Dominion Fuel Controller with great success, and he has been and still is active in a number of other departments of public life.

The permanent staff and employés at the Bangor City Electricity works recently presented Mr. PRICE F. WHITE with an oak bureau to celebrate the twenty-fifth anniversary of his appointment as manager of the works. Mr. Goodwin, the assistant manager, presided, and the presentation was made by Mr. John Jones, the oldest member of the staff, who is 76 years of age.

Stirling Town Council has appointed Mr. ALEX. BREWSTER as electrician for the ensuing year.

Mr. R. J. MILLARD has left the Electrical Apparatus Co., Ltd., and has joined the staff of Brookhirst Switchgear, Ltd.

Mr. E. H. PARSONS, A.M.I.Mech.E., A.M.I.E.E. ("The Buffs," Reserve of Officers), late chief electrical and mechanical engineer to the British Empire Exhibition, has been appointed electrical and mechanical engineer adviser to the Chief Engineer of the British Forces in Iraq.

Mr. R. P. Sloan, the chairman and managing director of the Newcastle-upon-Tyne Electric Supply Co., Ltd., informs us that Mr. H. A. COUVES, M.I.E.E., has been appointed general manager of that company and the following of its associated companies:—Cleveland and Durham County Electric Power Co.; Cleveland and Durham Electric Power, Ltd.; County of Durham Electric Power Supply Co.; County of Durham Electrical Power Distribution Co., Ltd.; Houghton-le-Spring and District Electric Lighting Co., Ltd.; and the Northern Counties Electricity Supply Co., Ltd. Mr. Couves, who joined the Newcastle company some 20 years ago, has occupied the position of chief of the Power and Construction Departments during the greater portion of that period.

Capt. A. D. GANGE, of Messrs. Siemens Bros. & Co.'s cable ship *Faraday*, has recently retired from that position after 22 years in the company's service, 17 of them as captain. Capt. Gange is a lieut.-commander (ret.) of the Royal Naval Reserve. He is succeeded by Capt. ALLAN.

On the occasion of his leaving the employ of Stalybridge Hyde, Mossley, and Dukinfield Tramways and Electricity Board to take up a position with the Yorkshire Electric Power Co., Mr. JAMES HALKETT was presented with a slide rule and fountain pen by the chief engineer and members of the staff.

Mr. E. R. PEACOCK has resigned from the position of president of the Barcelona Traction, Light and Power Co., Ltd. He retains his seat on the board, and will continue to act as chairman of the Bondholders' Committee. Mr. H. MALCOLM HUBBARD, vice-president, has been appointed chairman of the company, and Mr. F. FRASER LAWTON, general manager of the subsidiaries in Spain, has been appointed president, and will continue to manage the Spanish subsidiaries.

Mr. JUSTUS ECK has retired from the position of director of the Photector Co., Ltd.

Mr. V. DELEBECQUE has joined Messrs. "Manda" Motors, Ltd., London, as general manager..

We regret to learn that, owing to serious illness, Mr. A. P. Lundberg (who, by the way, is now in his 95th year) was unable to be present at what was an interesting domestic function in connection with his firm—A. P. Lundberg & Sons, of Liverpool Road, N. Bonuses have been offered to the employés for many years past for good time-keeping, and an average of about 20 per cent. of the workers usually qualify for the honour. This Christmas an exceptional opportunity arose in the celebration of a 21 years' "No time lost" record, and as an appreciation of such a feat Mr. ERNEST G. BURRELL was presented by the firm with an inscribed gold watch. Mr. G. C. Lundberg, M.I.E.E., made the presentation on his father's behalf.

Mr. J. W. SUTTON has retired from the position of manager of Messrs. George Kent, Ltd., after 60 years' service.

It is stated that Senatore MARCONI will be one of the first members of the new Italian Academy of "Immortals."

On leaving the works of the British Insulated Cables, Ltd., Helsby, to take up another appointment, Mr. J. P. HIGHAM, a member of the technical staff, was presented with a leather suit case by Mr. T. G. Briant, on behalf of the staff.

Obituary.—MR. J. M. M. MUNRO.—We regret to learn that Mr. John M. M. Munro, F.R.S.E., M.I.E.E., died at the residence of his son, Mr. Donald Smeaton Munro, Edinburgh, on December 30th after a short illness. Mr. Munro was born in 1853 and became interested in telegraphy at an early age. Shortly after the invention of the telephone he commenced the manufacture of telephone instruments, and, we are informed, erected in 1877 the first complete practical overhead telephone line in Glasgow. In 1878 he invented and put on the market an incandescent electric lamp with a metallic filament; this received favourable attention in France and other countries. In 1880 his firm (Anderson & Munro) installed arc lamps at the offices of the *Glasgow Herald*, and in the following year it assisted Sir Joseph Swan to display his lamps to Sir William Thomson (Lord Kelvin) and others, later arranging a public exhibition of arc and glow-lamp lighting. Before the close of that year (1881) installations were being carried out at Selkirk, Hawick, and Renfrewshire with wiring systems devised by Mr. Munro. Other pioneer work done by the firm was the lighting of a steamer and the partial lighting of collieries. A great many country house lighting sets were installed, many driven by water power and running to this day.

Lafayette] [*Glasgow.*

The Late Mr. J. M. M. Munro, F.R.S.E., M.I.E.E.

Mr. Munro was a prolific inventor, among the patents standing to his credit being those for a quick-break lever switch, a zig-zag armature winding, a gravity-balance volt and ampère-meter, an integrating wattmeter, concentric wiring, perforated interchangeable wall sockets and lampholders, and a public fire-alarm system. As a consulting engineer he carried out many important works in the Glasgow district, and in 1892 he was called to Norway to advise on large hydro-electric schemes for the lighting of Christiania and elsewhere; in this connection his plans were approved by the late Lord Kelvin. Since 1910 he had acted solely as a consultant among his later jobs being the change-over to bulk supply of the Bo'ness Town Council and the extensions at Cambuslang of the Lanark County Council. During the war Mr. Munro was attached to the Royal Flying Corps, when he had charge

of the construction and testing of seaplanes. Mr. Munro was one of the founders of the Scottish Section of the I.E.E., and was an associate member of the Institution of Civil Engineers. The funeral took place on December 31st in the Dean Cemetery, Edinburgh.

DR. GEORG KLINGENBERG.—By the death of Dr. Georg Klingenberg on December 7th, in Berlin, to which we briefly referred last week, electrical engineering in Germany has lost one of its leading agents and one whose name will long be remembered in connection with electricity supply operations.

The Late Dr. Georg Klingenberg.

Born in Hamburg in 1870, Dr. Klingenberg was educated at Osnabruck and Charlottenburg; at the latter place he became assistant to Prof. Slaby, a position which he held for some years. Although he devoted much attention to the theoretical side of electricity and engineering, as quite a young man he showed a strong desire to engage on the practical side of electricity supply development, and struck out into what at that time were entirely new directions. Thus in 1894 a central electric station in which superheated steam was utilised was built to his designs at Brettstedt, while in 1895 he prepared plans for a station at Marne, which was notable as being the first on the three-wire 2 x 220-V system, this being followed by increasingly large installations at Stettin, Charlottenburg, Halle, and Potsdam. Further evidence of his active brain came in 1896 when he made a notable contribution to the subject of the influence of high voltages on economical electricity transmission, and it was not long ere Klingenberg's name became well known far beyond the confines of his own country. Being able to demonstrate that his ideas were sound, it was notable, although under the circumstances not surprising, that by 1902, when he was only 32 years of age, he was appointed a director of the great Allgemeine Elektricitäts Gesellschaft, of Berlin, and the commencement of his association with this concern is generally considered to mark a new era in central electricity generating station design and construction. With the A.E.G. resources behind him, Klingenberg set out to thoroughly overhaul every section of central station work and design, from the method of storing and handling the coal to the distribution of the current, boiler-house arrangement coming in for a large share of his attention, as a result of which the *E. T. Z.*, to which we are indebted for the accompanying portrait, claims that the construction costs of power stations were reduced to less than half and their efficiency considerably increased. As further evidence of Dr. Klingenberg's unceasing activities, it may be mentioned that over 70 electric power stations have been built to his designs; of these a third are in foreign countries, one of the most notable being the four plants of the Victoria Falls Power Co. in South Africa, with a total capacity of 288,000 h.p. Another important installation was the Golpa power station of 128,000 kW, near Bitterfeld, Germany, which, when completed, was the largest steam-operated plant in the world. Dr. Klingenberg has not lived to see the completion of what was to prove his last and greatest work—the super power station on Lake Rummelsburg to meet Berlin's ever-increasing demand for electric power. Commenced in July last, this plant is to be completed by next autumn. Honours were showered upon him by the German Government and by the various technical institutions and scientific bodies. He had occupied the position of president of the Verband Deutsche Elektrotechniker, and there was hardly a technical commission or committee upon which he did not serve. It will be remembered that Dr. Klingenberg visited this country just prior to the war and put forward suggestions as to the way the problem of London's electricity supply should be tackled.

MR. R. T. BROWN.—Mr. Robert Thomas Brown, late of the West India and Panama Telegraph Co., Ltd., passed away at Westcliff-on-Sea on December 25th.

The funeral took place on December 30th of MR. ROBT. A BIRTLES, who had occupied the position of Chief Inspector of the Blackpool Corporation Tramways for 20 years. He entered the service of the Corporation in 1899 as a conductor. He was promoted to driver and then inspector and in six years rose to the position of chief inspector.

New Companies Registered.

Lydbrook Cables, Ltd. (210,609).—Private company. Registered December 23rd. Capital, £50,000 in 10s. shares. The objects are:—To carry on the business of chemical, civil, electrical, mechanical, mining, and radio engineers, manufacturers of cables and wires of all kinds, whether insulated or not, manufacturers of insulating materials, india-rubber and gutta-percha, vulcanisers, manufacturers of all electrical equipment and appliances, &c. The subscribers (each with one share) are:—F. B. Turner, 3-4, Clement's Inn, Strand, W.C.2, solicitor; J. F. H. Templer, 13, Inglis Road, Ealing, W.5, solicitor's clerk. The first directors are to be appointed by the subscribers. Qualification, 10 shares. Remuneration as fixed by the company. Solicitors: Brown, Quayle & Bentley Turner, 3-4, Clement's Inn, W.C.2. Registered office: Lydbrook, Glos.

Burndept Wireless (Dublin), Ltd.—Registered in Dublin as a "private" company on December 14th, with a nominal capital of £5,000 in £1 shares. The objects are to adopt an agreement, dated December 4th, 1925, between Burndept Wireless, Ltd., Aldine House, Bedford Street, Strand, London, and Thomas Hempenstall, 12, Suffolk Street, Dublin, on behalf of Dixon & Hempenstall, and carry on business of manufacturers of, and dealers in wireless, telegraph, telephone, optical, and photographic apparatus, &c. The first directors are:—W. Burnham, Chislehurst, Kent; T. Hempenstall, "Woodfield," Rathfarnham, Co. Dublin; C. Neild, 3, Mountain View, Ranelagh, Dublin. Secretary: John Love. Registered office: 17, Dawson Street, Dublin.

Moreland Electric Welding Co., Ltd. (210,650).—Private company. Registered December 24th. Capital, £4,000 in £1 shares. Objects: To acquire the business of electric and other systems or means of welding, electricians, mechanical engineers, &c. The subscribers (each with one share) are:—J. L. Walters, 19, The Walk, Cardiff, solicitor; T. A. Tyrrell, 42, Loftus Street, Cardiff, clerk. The first directors are C. G. Moreland (permanent director and chairman), and others to be appointed by the subscribers. Remuneration, as fixed by the company. Secretary (*pro tem.*): T. A. Tyrrell. Solicitors: Phœnix & Levinson, 8, Dumfries Place, Cardiff. Registered office: Dumfries Chambers, 8, Dumfries Place, Cardiff.

Hendon Electric Lamp Co., Ltd. (210,709).—Private company. Registered December 29th. Capital, £1,995 in 1,900 20 per cent. preferred ordinary shares of £1 and 1,900 deferred founders' shares of 1s. each. The objects are to acquire the business of a factor, agent and dealer in connection with electric lamps, and all other descriptions of electrical goods, &c., carried on by Mrs. K. E. Falcke at 104, Southampton Row, Holborn, as the "Hendon Electric Lamp Co." The subscribers (each with one share) are:—C. D. Falcke, A.M.I.E.E., 104, Southampton Row, W.C.1, electrical engineer; M. E. Cavendish, 52C, Fulham Park Gardens, S.W.6, manufacturer's agent. The first directors are to be appointed by the company or subscribers. Qualification, £10. Secretary: T. P. Jones, 9, Ferndale Road, Gillingham, Kent.

Holophane, Ltd. (210,826).—Registered on January 1st as a "public" company, with a nominal capital of £100,000 in £1 shares. The objects are to acquire the business of Holophane, Ltd. (incorporated in 1910), together with all or any of the assets, including trade marks, numbered 215,730 and 215,063, and liabilities in connection therewith, to adopt an agreement with the said old company and its liquidator, to acquire and turn to account interests in any invention relating to illuminating, appliances, toolmaking, brass and metal founding, and the production, treatment, storage, application and use of electricity, and of any apparatus therefor; to carry on the business of an electric light company; to manufacture illuminating appliances and light globes, &c. Minimum cash subscription, 7 shares. The first directors are:—Lord Ernest Hamilton, 87, Elm Park Gardens, S.W.10 (director of Khedivial Mail Steamship and Graving Dock Co., Ltd.); Otis A. Mygatt, 156, Boulevard Haussmann, Paris (director of Société Anonyme Francaise Holophane); Major Robert Woodhouse, 9, Wilbury Grove, Hove (director of Barclay's Bank, Ltd.); Lawrence E. Jones, M.C., 15, Clewelands Gardens, W.2, barrister; Herbert H. Thompson, Rowhiti, Devonshire Avenue, Sutton, Surrey (director of Holophane, Ltd.); Mons. André Froget, 156, Boulevard Haussmann, Paris (director of Société Anonyme Francaise Holophane). Remuneration, £200 per annum (chairman, £300), and 15 per cent. of the surplus profits earned by the company in each year remaining after paying 12 per cent. on the ordinary shares in respect of such year, but exclusive of any sum brought forward from any previous year. Maximum additional remuneration in any one year, £2,500, divided between them. Secretary: J. Wyatt Ile. Solicitors: Herbert Reeves & Co., 42, Old Broad Street, E.C.2. The registered office is at Elverton Street, Vincent Square, Westminster.

E. A. Langrish & Co., Ltd. (210,825).—Private company. Registered January 1st. Capital, £15,000 in £1 shares (7,500 8 per cent. cumulative preference and 7,500 ordinary). Objects:—To carry on the business of manufacturers, factors and importers of, agents for and dealers in electrical and wireless plant, machinery, apparatus, accessories and equipment, electrical engineers and contractors, &c. The subscribers (each with one share) are:—D. H. Raphael, 55, Ellesmore Road, Chiswick, W.4, clerk; H. W. Clayton, 28, Sackville Street, W.1, clerk. The first directors are not named. Save as provided by contract to the contrary, the shares (initial or otherwise) shall be under the control of the directors, who may allot or otherwise dispose of the same to such persons on terms and conditions and at such times as the directors think fit and with full power to give to any person the call of any shares either at par or at a premium and for such time and consideration as the directors think fit. Provided that after 5,800 ordinary shares shall have been allotted, E. F. Lyons shall have the right of subscribing and receiving an allotment of 500 ordinary shares at par and subject thereto no allotment exceeding 65 per cent. of the ordinary shares to be issued from time to time shall be made in favour of any single or joint shareholder or shareholders. Solicitors: J. J. Edwards & Co., 28, Sackville Street, S.W.1. Registered office: Primrose House, 26/7, D'Arblay Street, Wardour Street, W.

Featherstone & Davey, Ltd.—Private company. Registered in Dublin December 18th. Capital, £1,000 in £1 shares. Objects: To carry on business as electricians, electrical contractors, electrical and mechanical engineers, &c. The directors are:—L. Featherstone, 73, Kenilworth Square, Rathgar, Dublin, electrical engineer; J. A. R. Lloyd, 73, Kenilworth Square, Rathgar, Dublin, electrical engineer. Registered office: 43, Fleet Street, Dublin.

W. A. C. Pulverisers, Ltd. (210,637).—Private company. Registered December 24th. Capital, £8,000 in 7,000 10 per cent. cumulative preference shares of £1 each and 4,000 ordinary shares of 5s. each. Objects: To carry on the business of licensees, manufacturers and vendors of the W. A. C. Pulveriser as formerly carried on by A. J. Henderson, J. W. S. Asquith, A. J. Jack, and W. A. Cloud as the "W .A. C. Pulveriser Co.," and to carry on the business of mechanical, electrical, motor, gas, hydraulic, sanitary, construction, civil, consulting, and general engineers, &c. The subscribers (each with one preference share) are:—A. J. Henderson, 6, Wells Road, Regent's Park, N.W., consulting engineer; E. H. Clifton, 6, Hatfield House, Great Titchfield Street, W.1, gentleman; W. A. Cloud, 54, Airedale Avenue, Chiswick, W., mechanical engineer. The first directors are to be appointed by the subscribers. Qualification, 100 shares. Secretary: E. H. Clifton.

E. L. Bentley Company (210,593).—Registered as a "private unlimited" company on December 23rd, with a nominal capital of £100,000 in 40,000 10 per cent. cumulative preference shares and 50,000 ordinary shares of £1 and 400,000 deferred shares of 6d. each. The objects are to acquire all or any part of or any share, percentage or interest of and in the copyrights of Bentley's Telegraph and other codes, Scott's Code and other codes, and the goodwill of the business carried on in connection therewith, and to carry on the business of codists, manufacturers, compilers, publishers and printers of codes and other publications, &c. The subscribers (each with one ordinary share) are:—P. H. Bentley, Grove End, Bagshot, mechanical engineer; W. H. Bentley, "Sunny Cot," Upland Road, Sutton, telegraph codist. E. L. Bentley is permanent governing director. On his death, P. H. Bentley, H. B. Bentley, and W. H. Bentley, if living and hold 100 shares each, shall become permanent directors, with £1,200 each per annum as remuneration. Secretary: G. Bradley, 71, Queen Street, E.C. Solicitors: Kimber Bull, Howland, Clappe & Co., 6, Old Jewry, E.C.

A. G. Lewis & Co., Ltd. (210,624).—Private company. Registered December 24th. Capital, £1,000 in £1 shares. Objects: To acquire the business of a wholesale wireless dealer carried on by A. G. Lewis at 1, Beach Cliff, Penarth, Glam. The permanent directors are:—A. G. Lewis, "The Bungalow," Beach Cliff, Penarth, Glam., wholesale wireless dealer; R. Olney, 18, Princess Street, Barry, Glam., electrical engineer. Registered office: 7, Pembroke Terrace, Cardiff.

Helsby Cables, Ltd. (210,738).—Registered as a private company on December 29th with a nominal capital of £2 in £1 shares. The objects are:—To carry on the business of manufacturers of and dealers in wire cables and lines of all kinds, electricians, engineers, suppliers of electricity and electrical machinery and equipment, &c. The directors are:—J. Taylor, Colomander, Mold, North Wales, manufacturer; J. A. Smith, 1, Sefton Court, Croxteth Gate, Liverpool, director of British Insulated & Helsby Cables, Ltd. Solicitors: Hill, Dickinson & Co., 10, Water Street, Liverpool.

J.M.O., Ltd. (210,713).—Private company. Registered December 29th. Capital, £100 in 1s. shares. Objects: To carry on the business of engineers, advisers, experts, consultants, contractors and the like in connection with wireless telephony or telegraphy, &c. The first directors are:—Jose M. Ortega (permanent managing director), Upper Wandle House, Wandsworth, S.W.18; Mrs. Florence M. Ortega, Upper Wandle House, Wandsworth, S.W.18. Qualification, 1 share. Remuneration as fixed by the company.

G. W. M. Electrical Co., Ltd. (210,701).—Private company. Registered December 29th. Capital, £100 in 5s. shares. Objects: To acquire the business of wholesale and retail dealers in and manufacturers and factors of electrical, radio and motor accessories now carried on at 43, Grafton Street, Tottenham Court Road, W.1. The permanent directors are:—A. B. Gregory, 29, St. Albans Road, Seven Kings, Essex; B. G. Williams, 6, Parliament Hill, Hampstead, N.W.; E. Morgan, "The Poplars," Mawneys Road, Romford, Essex. Secretary: E. Morgan. Registered office: 43, Grafton Street, Tottenham Court Road, W.1.

R. L. S. Syndicate, Ltd. (210,614).—Private company. Registered December 23rd. Capital, £5,000 in £1 shares (4,000 ordinary and 1,000 deferred). Objects: To acquire the benefit of an agreement between C. G. Moller and J. Balfour Brown for the acquisition by the latter of certain British and foreign patent rights of S. G. Moller's patent rotary luminous sign. The first directors are:—F. V. Spooner, The Cavalry Club, 127, Piccadilly, W. (managing director of Slogasigns, Ltd.); J. Balfour Brown, 193, Mitcham Lane, Streatham, S.W.16 (director and secretary of Slogasigns, Ltd.). Qualification, 10 shares. Secretary: J. Balfour Brown. Registered office: 20, Grosvenor Gardens, S.W.1.

E. P. Allam & Co., Ltd. (210,698).—Private company. Registered December 29th. Capital, £6,000 in £1 shares. Objects:—To acquire the business of an electrical engineer, contractor and manufacturer, carried on by E. P. Allam at 107 and 109, Gray's Inn Road, W.C.1. The directors are:—E. P Allam, "Norton Garth," Gidea Park, Essex, electrical engineer; E. B. Allam, "Norton Garth," Gidea Park, Essex, electrical engineer. Qualification, £10 shares. Secretary: E. T. Sheppard. Solicitors: Cohen, Dunn, Page and Moore, Audrey House, Ely Place, E.C.1. Registered office: 107 and 109, Gray's Inn Road, W.C.1.

Electrolines, Ltd. (210,743).—Private company. Registered December 30th. Capital, £1,000 in £1 shares. Objects:—To acquire the business of an electrician and manufacturer of and dealer in wireless fittings now carried on by A. E. Finch at 5, Denmark Street, Bristol, and to carry on the same and the business of opticians, optologists, spectacle, opera glass, field glass and optical lantern makers, &c. The first directors are:—C. Jarrett, Maybury Villas, Keynsham, Somerset; E. Lewis, Sonoma, Abbots Leigh, near Bristol; A. E. Finch, 9, Denmark Street, Bristol. Solicitors: David Johnstone & Co., Bristol.

Detex Distributors, Ltd. (210,751).—Private company. Registered December 30th. Capital, £2,000 in £1 shares. Objects:—To adopt an agreement with Detex, Ltd., for the sole selling agency in the U.K. and Ireland of "Detex crystals," and to carry on the business of wireless agents, manufacturers, importers and exporters of and dealers in wireless instruments, parts and goods, &c. The subscribers (each with one share) are:—L. E. Parsons, 108, Victoria Street, S.W.1, insurance broker; C. A. E. Knust, 108, Victoria Street, S.W.1, insurance broker. The first directors are:—L. A. Bennett, W. T. Asher and R. Eiser. Qualification, 25 shares. Remuneration as fixed by the company. Secretary: W. T. Asher, 196, Ribbledale Road, Streatham, S.W.16.

Official Returns of Electrical Companies.

X. L. O. Co., Ltd.—W. C. Norrington-Wood, of 22, St. Stephen's House, Westminster, S.W., was appointed receiver and manager on November 27th, under powers contained in debenture dated July 9th, 1925.

Frederick Braby & Co., Ltd. (2,537c).—Capital, £660,000 in 42,500 ordinary, 17,500 preference, and 6,000 employés' shares of £10 each. Return dated September 1st, 1925. 39,500 ordinary, 14,500 preference, and 4,500 employés' shares taken up and fully paid. Mortgages and charges, £31,000.

Telephone Manufacturing Co., Ltd.—Particulars filed of £10,000 debentures and premium of 2 per cent. authorised December 3rd, 1925, and covered by trust deed dated February 17th, 1922, and endorsement thereon, dated December 16th, 1925, and ranking *pari passu* with £300,000 already registered, the whole amount being now issued. Property charged: The premises comprised in said trust deed. Trustees: London City and Midland Executor and Trustee Co., Ltd., 5, Princes Street, E.C.2.

Electric Light and Power Contracts Finance Corporation, Ltd.—Particulars filed of £50,000 debentures and premium of 5 per cent. authorised by resolutions of November 30th and December 3rd, 1925, charged on the company's assets, present and future, including uncalled capital, the whole amount being now issued.

Electric Reduction Co., Ltd. (51,724).—Capital, £50,000 in 16,200 preference and 33,800 ordinary shares of £1 each. Return dated November 23rd, 1925. 16,200 preference and 28,800 ordinary shares taken up. £18,000 paid on 13,000 preference and 5,000 ordinary shares. £27,000 considered as paid on the remainder. Mortgages and charges, £25,000.

Implitico, Ltd. (138,160).—Capital, £3,000 in £1 shares. Return dated December 2nd, 1925. All shares taken up. £3,000 paid. Mortgages and charges, nil.

Empson Electrical Engineering Co., Ltd. (188,208).—Capital, £2,000 in £1 shares. Return dated August 7th, 1925. All shares taken up. £500 paid. £1,500 considered as paid. Mortgages and charges, nil.

Kidderminster and District Electric Lighting and Traction Co., Ltd. (59,972).—Capital, £100,000 in 5,000 preference and 5,000 ordinary shares of £10 each. Return dated June 30th (filed November 4th), 1925. 3,000 preference and 4,700 ordinary shares taken up. £77,000 paid. Mortgages and charges, nil

Newton Bros. (Derby), Ltd. (139,711).—Capital, £76,000 in 75,000 ordinary and 1,000 employés' shares of £1 each. Return dated October 14th, 1925. 75,000 ordinary shares taken up. £30,000 paid. £45,000 considered as paid. Mortgages and charges, £62,000.

J. G. White & Co., Ltd. (66,568).—Capital, £350,000 in 400,000 ordinary shares of 5s. each and 70,000 ordinary and 180,000 preference shares of £1 each. Return dated October 9th, 1925. 400,000 5s. ordinary and 180,000 preference shares taken up. £200,000 paid on 150,000 preference and 200,000 ordinary shares. £80,000 considered as paid on 30,000 preference and 200,000 ordinary shares. Mortgages and charges, nil.

St. Austell and District Electric Lighting and Power Co., Ltd. (66,382).—Capital, £20,000 in 13,000 preference and 7,000 ordinary shares of £1 each. Return dated October 19th, 1925. 3,000 preference and 6,152 ordinary shares taken up. £9,002 paid (being £1 per share on 3,000 preference and 5,552 ordinary, and 15s. on 600 ordinary shares). Mortgages and charges, £1,850.

Baxter & Caunter, Ltd.—Satisfaction to the extent of £300 on February 23rd, and to the extent of £400 on December 3rd, 1925, of debenture and mortgage, both dated June 23rd, 1924, securing £5,000. (Notice filed December 23rd.)

Specialities (Liverpool), Ltd.—C. M. Delby, of 51, North John Street, Liverpool, ceased to act as receiver or manager on December 17th, 1925.

Lustrolux, Ltd.—Debenture dated December 10th, 1925, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: O. W. Porritt, Torside, Helmshore, Lancs. Also second mortgage debenture of the same date to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital (subject to above debenture). Holder: W. L. Turner, Abbey Manor, West Kirby, Cheshire.

Reflex Radio Co., Ltd.—Particulars filed of £1,000 debentures authorised December 15th, 1925, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

Izzard Brothers, Ltd.—Particulars filed of £1,500 debentures authorised December 15th, 1925, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

Walker, MacEwen & Co., Ltd.—E. L. Holford, of 41, Nightingale Road, Wanstead, E.11, was appointed receiver on December 22nd, 1925, under powers contained in debentures dated November 30th, 1922.

Walbar Engineering Co., Ltd.—Debenture dated December 11th, 1925, to secure £250, charged on the company's property, present and future, including uncalled capital. Holder: H. Langley, 96, Lightcliffe Road, Huddersfield.

City Notes.

Reports and Meetings of Electrical Companies, Dividend Results, &c.

Marconi's Wireless Telegraph Co., Ltd.

The directors have announced that it is not proposed to pay an interim dividend on the ordinary shares. The preference dividend for the latter half of 1925 was paid on January 1st. The passing of the interim ordinary dividend is due to circumstances which are set forth in a circular issued to the shareholders, and to the necessity of conserving to the utmost the cash resources of the company to meet the great programme of expenditure. The circular reads as follows:—

"Shareholders have from time to time been informed that the company was engaged in negotiating with the Postmaster-General a licence for the conduct of telegraph services between Great Britain and foreign countries. The directors are glad to be able to state that these negotiations have now been brought to a satisfactory conclusion and that the agreement embodying the terms of the licence was signed yesterday (December 31st). In addition to the services which the company has been conducting with France, Spain, Switzerland, Austria and the United States, it is now licensed to conduct services with the following European countries: Denmark, Sweden, Finland, Russia, Portugal, Jugo-Slavia, Bulgaria, Turkey and Greece, and with all foreign countries outside Europe. Your directors feel sure it will be a source of gratification to the shareholders to know that after so many years of discussion, the company is at last in a position to proceed with the establishment of a world-wide wireless telegraph service.

"The Beam stations which the company is erecting for the British Government and for the Governments of the Dominions and India, are making satisfactory progress. It had been hoped that the Canadian and South African stations would be ready for working by the end of 1925, but their completion has been delayed by the illness of Senatore Marconi and Mr. Franklin. In spite of this handicap, Senatore

Marconi and his staff have been able, since the work of construction commenced, to make some important improvements in short wave communication which are to be embodied in the new stations. These changes have involved further delay, but your directors are confident that the result will be to make the stations more efficient and to secure for the company a larger revenue than was originally anticipated. The directors are of opinion that the Beam services between this country and Canada and South Africa should be ready for working in April next, and that the services with India and Australia will be in operation about the middle of August. A Beam station is being erected at Dorchester for communication with the United States and with South America. A corresponding station is being built in Brazil for the account of the consortium of the four Wireless Companies operating in South America. The company is also constructing stations connecting Portugal and her Colonies and linking up Portugal with the rest of the world.

"This programme of construction involves the expenditure of approximately £1,000,000 sterling. At no time in the history of the company has so much work been in hand in connection with the establishment of telegraphic services.

"At the last general meeting the managing director stated that the Board had determined to make such reductions in the company's expenditure as were possible without reducing the efficiency of the company's organisation. Reductions have already been made, and continue to be made at every possible opportunity, but the full effect will only be partially reflected in the accounts of 1925. A good deal has already been done to carry out the undertaking given at the last general meeting to close down those subsidiary companies which appeared to the Board not likely to become profit-earning in any reasonable period of time and the Board has also taken the necessary steps to reorganise other subsidiary companies whose results up to the present have been unsatisfactory. The sales side of the company's business continues to show satisfactory results.

"The preparation of the company's case for submission to arbitration in connection with its claim against the Government for the use of its patents by the fighting forces, before, during and since the war, has made a considerable advance, but the amount of work involved is so great that it is impossible to give any definite date when this will be completed. No effort is being spared by the company or the Government Departments to expedite the hearing.

"In consequence of your Board's efforts to effect a reduction in expenditure on the telegraph services, a lightning strike took place on November 2nd. The matter was referred by the company to the Engineering and Allied Employers' London and District Association, and a provisional agreement was arrived at whereby the telegraphists returned to duty pending further discussion. These discussions have not yet led to a satisfactory settlement. A strike has also taken place of the operators in the employ of the Marconi International Marine Communication Co., Ltd., in which company the Wireless Company is a large shareholder. This strike was declared by the same Union as was responsible for the lightning strike at Radio House and is still proceeding."

Tata Power Co. In their report for the year ended June 30th last, the directors state that they have acquired practically all the land required for the works, except the transmission line, for which 60 out of 76 miles has been acquired. The progress on the dam has been satisfactory, and it is hoped that the masonry will be of sufficient height by June, 1926, to permit of the supply of power. Sufficient pipes have been received to allow of two generators being put into commission. About half of the generating station has been completed and some machinery has been received. At the receiving station a commencement has been made with the erection of switchgear. At the end of the year under review the unpaid calls amounted to Rs.137 lakhs, but since then Rs.13 lakhs has been paid up.

Leicestershire and Warwickshire Electric Power Co.—It is reported that the company is seeking Parliamentary powers to raise its capital by the creation of £500,000 in £1 ordinary shares, and to increase its borrowing powers by £122,970. It also seeks to obtain the power to further increase its borrowing powers by means of Special Orders. The company also proposes to divide its £10 ordinary shares into £1 shares.

Edison Swan Electric Co., Ltd.—At an extraordinary general meeting on January 4th resolutions were confirmed authorising the sub-division of the unissued £1 ordinary shares of the company into shares of 4s. each.

C. A. Vandervell & Co., Ltd.—It is reported that more than 75 per cent. of the holders of each class of share have accepted the offer to purchase their holdings made by Messrs. Thomson, McLintock & Co.

It is stated that the offer was made on behalf of Messrs. Joseph Lucas, Ltd., and that there will be no change in the management of the concern.

Crompton & Co., Ltd.—An interim dividend at the rate of 7 per cent. per annum on the preference shares for the half-year ended September, 1925, is payable on January 9th.

Stock Exchange Notices.—The undermentioned securities have been ordered to be officially quoted:—

Telephone Manufacturing Co.—£10,000 eight per cent. cumulative income bonds of £100 each, Nos. D1 to D100 (registered).

Stocks and Shares.

MONDAY EVENING.

IN the endeavour, usually made at this time of year, to forecast in some rough shape the manner in which Stock Exchange markets may be expected to move, the natural temptation is to lean to the optimistic side. Everybody hopes for the best. Common or garden charity dictates a sympathetic desire that prices may rise for the sake of those people who hold the stocks and shares. Nor, speaking "big and large," as the modern repetition of an old phrase says, is there any tangible reason for anticipating that prices should proceed in a way other than satisfactory to the holders of securities. Despite the 5 per cent. Bank Rate, money is the reverse from being tight. The course of trade, national and international, is still too sluggish for it to demand any but normal supplies of cash with which to finance its requirements.

The prospect for the prices of Home Railway and London Traction issues is not encouraging. The Underground group approaches the limit of its present capacity for expansion. "Pirate" 'bus competition has an influence upon the takings of the Combine. The latter is run by men of energy, experience, and imagination. Yet the return upon the large amount of capital invested in this group is meagre, and there will be no such adventitious Wembley aid as the last two years have provided. It is to be hoped, however, that a start will be made this year in the reorganisation of the capital account of the Underground Electric Railways of London, hitherto hung up by the divergence between the London and the New York rates of exchange.

Brazilian Tractions are not likely to enjoy another such dramatic rise in value as that which occurred in 1925. The bull bases his impression of further advance upon the persistent report of American-Canadian interests buying the shares for control. Confident anticipation of a rise in the dividend is always a factor, and so is, of course, the consideration that the company is doing well. The Mexican group of utility companies must depend for their progress upon the political and financial march of events in the country. Contrary to a general hope, the recognition of Mexico by Great Britain has led, so far, to little change in the immediate outlook.

British Columbia Electric stocks can be looked upon as sound speculative investments. The company goes ahead, in Vancouver, with the same steady persistence as characterises the soundly-managed British Electric Traction Company at home.

The New Year is bound to witness important developments in connection with the London electricity supply industry. Optimism talks with no hesitating tongue of the dividend declarations so soon to be announced in respect of 1925. Again, the far-reaching changes that will come about so shortly by the operation of the new Parliamentary Acts are thought likely to benefit share prices. Some of these have been put up well ahead of the actual event. If the various rearrangements of capital result in the provision of additional shares in which to deal, this will be of distinct advantage to a market which, for years past, has suffered from the disability of a restricted supply of stock with which to satisfy would-be investors. The group will be extended by the admission into it of shares, &c., in various provincial undertakings. Rumour plays with the idea that Americans are already endeavouring to obtain a footing in British electricity supply, through the medium of lighting and power undertakings well outside the London area.

While the cable companies, embarked upon a policy of strict retrenchment of expenses, can be expected to maintain earnings and dividends, it is hard to say what the immediate future holds in store for the wireless concerns. One of the few Stock Exchange disappointments last year was furnished by the gradual dwindling in the price of Marconis. A strike of wireless operators was a kind of last straw, but prices have now descended to such low levels as seem to make a sale indiscreet. The rubber boom, which formed the outstanding feature of last year's markets, laid a check upon the previous hectic rush in the shares of various cable equipment companies. This check proved to be little more than temporary. Prices in the cable section, and in that for electrical manufacturing shares, are very hard. The buying has been mainly of the investment order, and the shares purchased were paid for by the supporters. This suggests the possibility of further improvement, although there are not wanting cautious folk to indicate the substantial character of the rise as a reason for not anticipating much more advance at present. There is, however, a spice of speculation in this particular department owing to the rapidity of changes which take place in the realms of labour, politics, trade, and finance. "One never knows," says the Stock Exchange platitude.

Share List of Electrical Companies.

	Nom. £	Dividend. 1923.	1924.	Price Jan. 4 1926.	Rise or fall.	Yield. p.c.
HOME ELECTRICITY COMPANIES.						
Bournemouth and Poole	1	13	14	29/6	—	4 14 1
Brompton Ordinary	1	10	10	14½	+1/16	*5 18 6
Charing Cross Ordinary	1	14½	15	27/6	—	6 3 1
do. do. 4½ Pref....	1	4	4½	17/6	—	5 2 10
Chelsea	1	12	12	24	—	5 18 0
City of London	1	15	15	30/9	—	5 18 1
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	20/6	—	5 8 6
County of London	1	15	15	30/6	—	5 0 10
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	1	7	7	24/6	—	5 14 8
do. 7% Pref.	1	6	7	31/6	—	6 10 8
Elec. Supply Corporation ...	1	10	10	32/6	—	6 3 0
Kensington Ordinary	5	14	15	13½	—	5 13 2
Lancs. Light and Power	1	7½	7½	26/-	—	5 15 5
London Electric	1	10	10	33/6	—	5 19 5
do. do. 6% Pref....	5	6	6	5⅛	—	5 7 10
Metropolitan	1	10	11	40/6	—	5 8 7
do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Midland Counties	1	5½	6	23/9	—	5 1 1
Newcastle-on-Tyne Ordinary ...	1	6	7	22/6	—	6 4 5
do. 5% Pref. ...	1	5	5	18/9	—	5 6 8
do. 7% Pref. ...	1	7	7	24/6	—	5 14 8
Notting Hill 6% Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6% Pref. ...	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	17½	15½	−½	5 14 9
South London	1	15	15	28	—	5 18 1
South Metropolitan Pref. ...	1	7	7	11½	—	5 12 8
Urban Ordinary	1	4	4	18/3	—	4 7 8
do. 6% Pref. ...	1	6	6	18/9	—	6 8 1
Westminster Ordinary	1	15	15	48/-	+1/6	6 5 0
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	19/6	−6d.	7 13 10
kshire Elec.	1	8		30/6	—	5 5 0
HOME RAILS.						
Central London Ord. Assented	Stock	4	4	68	—	5 17 8
Metropolitan	,,	4	5	69	—	7 5 0
do. District	,,	3½	3½	47½	+½	7 7 4
Underground Electric Ordinary	10	Nil	Nil	2½	—	Nil
do. do. "A" ...	1/-	Nil	Nil	7/-	—	Nil
do. do. Income	Bonds	6	6	98	—	*6 2 5
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	103	—	5 16 6
do. Def.	,,	1½	1½	34⅞	—	6 0 8
Automatic Telephone	1	8	6	51/3	—	2 6 10
Chili Telephone	5	6	5	6⅞	—	*4 7 0
Cuba Sub. Ord.	10	5	5	6½	—	7 8 2
Eastern Extension	10	10	10	18	—	*5 9 7
Eastern Tel. Ord.	Stock	10	10	177½	—	*5 12 8
Globe Tel. and T. Ord.	10	10	10	18⅜	−⅛	*5 3 11
do. do. Pref.	10	6	6	11	—	8 4
Great Northern Tel.	10	22	22	33	—	6 13 4
Indo-European	25	7	8½	45½	—	*4 13 5
Marconi		10	10	1½	—	9 17 10
Marconi Marine	1	10	7½	⅞	—	8 11 6
Oriental Telephone Ord. ...	1	12	12	42/6	—	*5 12 11
United R. Plate Tel.	5	8	8	7½	+1/16	5 2 5
Western Telegraph	10	10	10	18	—	*5 11 1
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams First Pref. ...	5	5½	5½	8¼	—	6 9 2
do. do. 2nd Pref. ...	5	6	6	9⅛	—	9 8 2
do. do. 5% Deb. ...	Stock	5	5	73½	—	6 16 3
British Electric Traction Ord. ...	,,	6	6	119½	—	5 0 0
do. do. 6% Pref. ...	,,	6	6	105	—	5 14 8
Brazil Traction	100	4	4	85	+½	4 14 2
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	86½	—	5 17 0
do. do. Preferred	,,	9/6	9/6	104½	+2	*4 11 1
do. do. Deferred	,,	129/6	129/6	127½	+3	*5 2 0
do. do. Deb.	,,	4½	4½	77	—	5 10 5
Lond. & Sub. Trac. 5% Pref. ...	1	2½	Nil	3/6	—	Nil
London United Tram. Deb. ...	Stock	4	4	43½	—	9 8 4
Mexico Trams, 5% Bonds ...	—	5	5	61½	—	8 2 8
Mexican Light Common ...	100	Nil	Nil	8½	—	Nil
do. Pref.	100	Nil	Nil	6½	—	Nil
do. 1st Bonds ...	—	5	5	70½	−1½	7 1 10
Yorkshire (West Riding) ...	1	5	—	18/9	—	5 6 8
MANUFACTURING COMPANIES.						
Babcock & Wilcox	1	12	12	51/3	—	*4 13 4
British Aluminium Ord.	1	5	10	38/-	—	5 5 3
British Elec. Transformer Pref.	1	Nil	7	1	—	... ...
British Insulated Ord.	1	— 15	15	2½	+1/16	5 6 3
Brush Ord.	1	10	10	28/-	+1/-	7 2 10
Callenders	1	15	15	3½	—	4 12 4
do. 6½% Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	Nil	Nil	16/3	—	... ...
Edison-Swan	4/-	10	10	9/3 xd	+3d.	4 6 6
do. 5% Deb.	Stock	5	5	85	—	5 17 8
Electric Construction	1	10	10	32/6	—	6 3 0
Enfield Cable, Pref.	1	7½	7½	1½	—	6 0 0
English Electric	1	5	5	19/3	+9d.	5 3 11
do. do. Pref.	1	6	6	20/6	−6d.	5 17 1
Gen. Elec. Pref.	1	6¾	6¾	24/-	+6d.	5 8 4
do. Ord.	1	5	7½	29/3	+1/3	5 2 7
Henley	1	15	15	3½	—	4 11 5
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	5	1⅛	—	*4 14 1
Johnson & Phillips	1	10	10	56/3	—	3 11 1
Met-Vickers, Ord.	1	8	8	27/-	—	5 18 6
do. Pref.	2	8	8	28	—	6 14 9
Siemens Ord.	1	—	7½	33/-	+9d.	4 5 9
Telegraph Construction	12	20	20	27	—	*4 9 0

*Dividends paid free of Income Tax.

Market Quotations for Chemicals and Metals.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price January 5th.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	6¾d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£35	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	6½d.	...
a Shellac ... ... per cwt.	£15 15s.	...
a Sulphur, Commercial ... ... ,,	£8 10s.	...
a ,, Roll ... ... ,,	£8 10s.	...
a Soda, Chlorate ... ... per lb.	3½d. to 3¾d.	...
a ,, Crystals ... ... per ton	£5 to £6 5s.	...
a Sodium Bichromate, casks ... per lb.	4d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£120 to £125	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/8 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		...
Grade I ... ... per ton net	£257	£5 inc.
Grade II ... ... ,, ,,	£182	£3 inc.
Grade III ... ... ,, ,,	£101	£2 inc.
c Brass (rolled metal 5" to 12" basis) per lb.	9½d.	...
c ,, Tubes (solid drawn) ... ,,	1/- to 1/0½	...
c ,, Wire, basis ... ... ,,	10½d.	...
c Copper Tubes (solid drawn) ... ,,	1/1	...
c ,, Bars (best selected) ... per ton	£90	...
c ,, Sheet ... ... ,,	£90	...
c ,, Rod ... ... ,,	£90	...
d ,, (Electrolytic) Bars ... ,,	£66 5s.	...
d ,, ,, Sheets ... ,,	£148 10s.	...
d ,, ,, Wire Rods ... ,,	£76 5s.	...
d ,, ,, H.C. Wire per lb.	9⅞d.	...
f Ebonite Rod ... ... ,,	2/3 to 3/5	...
f Sheet ... ... ,,	2/3 to 2/6	...
a German Silver Wire ... ... ,,	2/2	...
h Gutta-percha, fine ... ... ,,	6/6	...
h India-rubber, Para fine ... ... ,,	3/10	9d. dec.
f Iron Pig (Cleveland Warrants) ... per ton.	nom.	...
f ,, Wire, galv. No. 8, P.O. qual. ,,	£12	...
g Lead, English Pig ... ... ,,	£37	£1 inc.
g Mercury ... ... per bot.	£15 to £15 5s.	...
e Mica (in original cases) small ... per lb.	3d. to 8/-	...
e ,, ,, medium ... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3½	...
p ,, ,, drawn bars & rods ,,	1/8	...
p ,, ,, rolled strip & sheet ,,	1/9½	...
p ,, ,, wire ... ... ,,	1/8½	...
c Platinum ... ... per oz.	£9s	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	7½d.	...
n Tin, Block (English) ... ... per ton.	£287 to £287 10s.	30s. to £2 ins
a ,, Wire, Nos. 1 to 16 ... ... per lb.	4/3	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
j Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co. Ltd.
o C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Lloyd's Register Scholarship.—A scholarship is annually awarded by Lloyd's Register of Shipping, worth £100 a year for three years, to a junior engineer or apprentice, as the result of a competitive examination. Particulars can be obtained from the Institute of Marine Engineering, 85-88, The Minories, London, E.1. Application must be made before March 10th.

A New Electrically-operated Fire Vehicle.—The latest turntable ladder fire vehicle introduced by Messrs. Tilling-Stevens Motors, Ltd., Maidstone, constitutes a formidable British challenge in a field hitherto successfully held by Continental makers, and again exemplifies the adaptability of the Tilling-Stevens petrol-electric propelling plant to duties requiring a supply of electricity. Known as type TTL2, the new vehicle utilises a T84 petrol-electric chassis with a four-cylinder engine developing 50-60 h.p., coupled direct to a compound-wound dynamo which supplies current to a series-wound motor driving the worm back axle through a propeller shaft. Consisting of one main and three sliding sections, the ladder is elevated by a motor with a vertical armature driving, through two sets of enclosed worm gear, a horizontal shaft with which are connected a pair of drums bearing twin steel-link elevating chains. The final 2 ft. of extension is accomplished at half speed, this being obtained by the introduction of resistance in the circuit. A dial indicator calibrated at 5-ft. intervals is provided in front of the operator, and is furnished with means whereby, when the ladder has attained any pre-determined height, the current is automatically cut off from the motor. A separate motor is employed for the operation of the ladder turntable, which is mounted directly above the back axle.

Conditions and Prospects in India.

Important Public Works.

MR. THOMAS M. AINSCOUGH, C.B.E., Senior Trade Commissioner in India and Ceylon, has forwarded a report on the conditions and prospects of British trade in India* to the Department of Overseas Trade. In a general review of the fiscal year 1924-5, Mr. Ainscough says that a general improvement was shown and the progress towards normal conditions was satisfactory. This improvement was very greatly contributed to by the improvement in the political situation and the subsidence of agitation. It is stated, however, that although the general economic condition of India is steadily improving, the import trade remains depressed and the future is still obscure. Competent observers have repeatedly emphasised the truism that so long as the Indian *rayat* is only receiving increased prices of little more than 30 per cent. for his produce, he cannot afford to purchase normal quantities of imported goods at rates varying from 100 to 170 per cent. higher than those ruling before the war.

So far as the engineering trades are concerned, the future largely depends on the progress of important public works, such as railway, irrigation, harbour, dock, canal, and hydro-electric schemes. In the iron and steel trade British exports are adversely affected by Continental competition, and to a lesser degree by the recent Indian protective tariff upon steel.

Foreign Competition in Import Trade.

In certain directions German competition in the import market has become prominent. In 1913-14 the German share of Indian import trade was 6.9 per cent. In 1923-24 it was 5.2 per cent., and during the following year it rose to 6.3 per cent. Mr. Ainscough says that he can find no foundation for the statement that the Germans are re-introducing extended credit terms and are giving better facilities than their British competitors. The share of Belgium in the import trade has remained fairly steady, at between 2.3 and 2.8 per cent. Over 60 per cent. of this consists of iron and steel manufactures which compete seriously with British products. American exports, after advancing steadily during and immediately after the war, declined considerably between 1920 and 1924, although they rallied slightly during the year under review. One of the principal items supplied by the United States is electrical instruments and apparatus, and American competition is also very keen in electrical machinery and in those types of machinery and tools where the large domestic market of the United States has enabled the American makers to standardise, and so reduce prices.

Electrical Imports.

The following table reproduced from the report shows the total imports of electrical machinery and the countries of consignment for the past three fiscal years :—

Countries of consignment.	1922-23. Rs. (lakhs).	1923-24. Rs. (lakhs).	1924-25. Rs. (lakhs).
United Kingdom ...	2,00	1,64	1,77
Germany	6	4	4
United States	38	41	15
Other countries	16	13	6
Total	2,60	2,22	2,02

It is considered most satisfactory that British manufacturers have increased their share of the trade at the expense of American and Swedish competitors. This, it is stated, is very largely due to the splendid service given by the Indian branches and agencies of the leading home stores, most of which employ highly qualified engineers and salesmen, who are continually touring the country and keeping in close touch with every project. Competition among them is very keen, and there is a great deal of price cutting, but the result is that foreign competition is not allowed to become really serious. The falling away in the total trade is largely due to reduced imports of motors, generators, transformers and turbo-generators. The unclassified imports, however, rose by nearly 29 lakhs. The most serious decline was in the case of motors, the value of which fell from 72 lakhs in 1913-14, to 40 lakhs in 1924-25. The development of railway electrification in India, which is dealt with subsequently, will provide an increasing market for electrical plant. British makers have supplied machinery, cables and apparatus for the first section of line to be electrified in India, *viz.*, the G.I.P. local service in Bombay.

The total value of imported electrical apparatus in 1924-25 was 197 lakhs, as compared with 226 lakhs in 1923-24. The most important item was electric wires and cables, which were valued at 67 lakhs as against 70 lakhs. By far the largest proportion of this apparatus came from the United Kingdom; Germany occupied the second place in 1924-5, supplanting the United States in this position.

Indian Stores Department.

It is the avowed policy of the Government of India to develop the purchase of stores as far as possible in India, granting a preference to articles manufactured, or partly manufactured, in the country and utilising the activities of the recently created Indian Stores Department, to stimulate the local manufacture of such articles. This department has already carried out a good deal of work, and it is stated that a notable advance has been made in the direction of authorising the purchase in India, from the branches and agencies of foreign manufacturers established in the country, of engineering plant and machinery, whether stocks are held in the country or not, and the department has thus been enabled to purchase at economic prices in India a considerable quantity of engineering plant and machinery which otherwise would have had to be purchased from England. The purchases covered by the department consist of a wide range of stores, and include complete electric power plants, railway materials, &c. During the past year the engineering branch purchased plant and materials for electrical installations to the value of Rs. 10,32,000. It is of interest to note that one item in which the United States has a monopoly is locomotive headlights. The report says that it is most unfortunate that British makers have not specialised in this type of fitting. One or two firms have been in negotiation with the Railway Board, but it seems doubtful whether they will be able to produce a suitable article and have it tested before the American lights are installed. The Director-General of the Department of Posts and Telegraphs, in his report for 1923-4 states that a tentative order for 100 tons of hard-drawn copper wire was placed in December, 1923, with the Indian Cable Co. of Jamshedpur (a concern managed by a British company) and that satisfactory deliveries were made during 1924. The Calcutta Pottery Works has increased its output of insulators, and it is hoped that in the near future this firm will be able to meet the entire requirements of the department for insulators, the annual value of which is about 5 lakhs. The services of the Indian Stores Department in Delhi-Simla are now being utilised to an increasing extent, and such items as oils, electric light and fan fittings, and various other stores, are now purchased through this agency.

Hydro-Electric Development, &c.

Work on the Lloyd Barrage made satisfactory progress during the year under review; a considerable quantity of plant arrived and was erected; the power house to supply electrical energy to works and township buildings, was in course of construction; and the first power unit was to be erected shortly. The report contains a list of plant which it is intended to purchase during the year 1925-6. This includes electric derrick and " Goliath " cranes, centrifugal pumps with electric motors, motors and starters, three 500-h.p. Diesel engines and alternators, transmission lines, township lighting equipment, &c. Considerable extensions are being carried out at the Port of Calcutta, and a great deal of up-to-date cargo handling machinery is being installed. The hauling gear of the sliding caissons and the capstans and penstocks at the entrances to King George's Dock will be operated hydraulically, but all other equipment will be operated electrically. For the supply of electrical energy the Port Commissioners have recently entered into a contract with the Calcutta Electric Supply Corporation, which is building and equipping a 12,000-kW generating station in the vicinity of King George's Dock. In case of accident in connection with this source of supply, current will be available from the present source, *viz.*, the Corporation's station at Cossipur, nine miles away, whence it is conveyed at a voltage of 30,000, transformed by the Calcutta Electric Supply Corporation to 6,000 volts, and by the Port Commissioners to a working voltage.

During 1925 the Punjab Legislative Council made the necessary grant of funds for the first year for the Punjab hydro-electric scheme (known as the Mandi project). With the exception of one or two minor details all the preliminary work has been carried through, and the engineer in charge hoped to commence work in the autumn of 1925. The project makes use of the snow-fed waters of the river Uhl, which joins the river Beas in Mandi State. The water will be carried through 2¼ miles of 9-ft. diameter tunnel through solid granite, and then dropped through a fall of 1,800 ft. to the first power station, where 36,000 kW can be generated. The construction of a comparatively small dam on an excellent site will increase the available power to 70,600 kW. From this point the water can be taken through three miles of open duct and dropped through a second fall of 1,200 ft., generating another 40,000 kW, making a total development of 118,600 kW, which is more than sufficient to meet the present demand in an area extending from Delhi in the south to Sialkot and Lyallpur in the north. There is also a third fall of 750 ft. which can be developed later if required, but this has not yet been surveyed. There is a sufficient market for power at present in existence to justify the first stage of the project and many promises have already been received to meet the annual expense for the first five years. The Government intends, therefore, to proceed at once with the construction of the first stage of the scheme, but to limit the transmission of power to certain towns. The construction of the project necessitates the provision of permanent railway communication with the power station. A meter gauge tramway will therefore be constructed from the existing rail head at Mukerian through the Kangra Valley, which has for many years been in need of improved communi-

* Stationery Office. 5s. 6d. net.

cations. The first stage of the project also includes a fund for assisting mill owners to install electrical equipment in mills on the hire-purchase system, at cost price, thereby encouraging the rapid replacement of steam by electricity as soon as the scheme has been completed. The cost of this first stage, including the tramway, local distribution, and the mill-owners' fund, amounts to Rs. 557 lakhs. It is expected that the scheme will take about 2½ to 4 years to construct. In the second stage of development, it is proposed to extend the transmission system so as to supply Simla, Ambala, Patiala, and other towns. This will render necessary the erection of a dam. The third stage of the scheme will carry power as far as Saharanpur, Meerut and Delhi. British manufacturers of the types of plant which will be required are advised to place themselves in touch with Lieut.-Col. B. C. Battye, D.S.O., R.E., Chief Engineer, Hydro-electric Circle, Punjab Government, Benmore, Simla.

Railway Electrification.

The first line to be electrified in India, reference to which has been made, was opened for service on February 3rd, 1925. The electrified section of the G.I.P. railway runs from the Victoria terminus, Bombay to Kurla, *viâ* the Harbour branch. In 1904 the problem of increasing the capacity of the G.I.P. suburban line received consideration, but the schemes now in progress did not take definite shape till 1913, when a well-known firm of consulting engineers advised the electrification of certain sections. The work was held up by the war, but projects for the electrification of the harbour branch and Mahim Chord, and of the Bombay-Thana section were accepted by the Secretary of State in August, 1922, while approval of the scheme from Thana to Kalyan was received in June, 1923. The work has been carried out by British engineers and the plant and equipment was almost entirely supplied by well-known British firms.

The B.B. & C.I. Railway Co. is also engaged on an extensive scheme of suburban line electrification in Bombay. Important contracts have been awarded to British firms, and the work will be pushed forward as rapidly as possible. In Calcutta the electrification of the suburban section of the Eastern Bengal and East Indian railways is also being considered. There is little doubt that railway electrification in India will be greatly extended in the future. Mr. Ainscough says that British manufacturers have secured a strong position by the excellence of the material and plant supplied on the first contracts.

Radio-Telegraphy and Telephony.

In March, 1925, the Indian Radio Telegraph Co., Ltd., was registered, with an authorised capital of 3 crores of rupees. The company was formed to erect radio-telegraph and telephone stations under Government concessions. It is intended in the first instance, to erect a station at Kirkee, near Poona, for the purpose of transmitting and receiving messages to and from Great Britain. It will be of the "beam" type, and the British Government has agreed to erect a similar station in England. The station was expected to be ready for service nine months from the date of the final approval of the plans by the Government and the acquisition of the site.

Broadcasting in India is still in its infancy and has not yet been carried out on a commercial scale. Radio clubs have been formed in some of the principal cities and experimental programmes are transmitted. Certain definite recommendations have been made by interested parties, to the Government, and as a result of these the Government has stated its willingness to grant a licence to a broadcasting company, subject to certain conditions.

So far the bulk of imports of radio apparatus has been of British origin; at present no apparatus is made locally, but possibly sets may be assembled locally from imported component parts. The foreign competition so far encountered is mainly from the United States, France and Germany.

Radio Apparatus in Latvia.—Under Clause 5 of the regulations governing the purchase and use of radio apparatus, issued by the Latvian Government, foreign radio sets and accessories may be acquired if such apparatus is not made in Latvia or is made in insufficient quantities. Periodical lists of this permitted apparatus will be published. A translation of the first list, supplied by the Department of Overseas Trade, includes "receiving apparatus with not more than four valves, as well with 2-4 valves (*sic*), without re-generation on first or second valves," in addition to a great number of parts and accessories, as transformers, valves, telephones, loud speakers, condensers, &c.

Power Station Radio Communication System.—The Italian Government has recently granted a concession to the Società Italiana Ernesto De Angeli, of Milan, to establish six wireless transmitting and receiving stations in connection with the electric power station at Ardesio (Bergamo) and at the transformer and distribution-sectionising stations at Ponte Nossa (Bergamo), Casellazzo (Milan), Legnano, and Milan. The purpose of the stations is to transmit by radio operating instructions to the engineers in charge at the different stations. The concession, which is run for a period of ten years, authorises a wave-length of 1,000 metres for the Bonate Supra and Castellazzo installations and 1,750 metres for the others. Messages are only to be transmitted between the hours of 7.30 and 9.30 a.m. and between 4 to 6 p.m., although in cases of emergency messages may be transmitted at any other time. The installations are stated to be the first of their kind in Italy.

The Import Trade of Siam.

THE following figures, showing the imports of electrical and similar goods into the port of Bangkok during the year ended March, 1925, are taken from the recently-issued official trade statistics; the figures for the year ended March, 1924, are included for the purposes of comparison, and notes of any increases or decreases are given. Imports stated to be from Singapore and Hong-Kong are for the most part the products of other countries shipped *viâ* these two ports:—

	1923-24. Ticals.	1924-25. Ticals.	Inc. or dec. Ticals.
Lamps.—			
Total	392,000	591,000	+ 199,000
From Singapore	59,000	88,000	+ 29,000
,, Hong-Kong	32,000	46,000	+ 14,000
,, United Kingdom ...	62,000	80,000	+ 18,000
,, United States	26,000	37,000	+ 11,000
,, Japan	80,000	76,000	– 4,000
,, Germany	78,000	203,000	+ 125,000
,, Sweden	36,000	45,000	+ 9,000
Electrical goods and apparatus.—			
Total	1,151,000	796,000	– 355,000
From United Kingdom ...	287,000	279,000	– 8,000
,, Germany	328,000	127,000	– 201,000
,, United States	118,000	119,000	+ 1,000
,, Singapore	22,000	19,000	– 3,000
,, Sweden	27,000	22,000	– 5,000
,, Italy	31,000	23,000	– 8,000
,, Holland	54,000	22,000	– 32,000
,, France	17,000	22,000	+ 5,000
,, Japan	32,000	86,000	+ 54,000
Manufactures of copper.—			
Total	71,000	55,000	– 16,000
From United Kingdom ...	32,000	19,000	– 13,000
,, India	6,000	3,000	– 3,000
,, Germany	20,000	12,000	– 8,000
,, France	5,000	500	– 4,500
Scientific instruments and apparatus.—			
Total	217,000	249,000	+ 32,000
From United Kingdom ...	84,000	77,000	– 7,000
,, Germany	23,000	32,000	+ 9,000
,, France	6,000	10,000	+ 4,000
,, Japan	23,000	39,000	+ 16,000
,, United States	28,000	35,000	+ 7,000
,, Denmark	7,000	1,500	– 5,500
,, Belgium	10,000	—	– 10,000
Prime movers, other than locomotives, marine, military, and agricultural machinery.—			
Total	321,000	165,000	– 156,000
From United Kingdom ...	129,000	75,000	– 54,000
,, United States	132,000	6,000	– 126,000
,, Germany	15,000	32,000	+ 17,000
,, Denmark	28,000	6,000	– 22,000
Machine tools.—			
Total	142,000	186,000	+ 44,000
From United Kingdom ...	89,000	71,000	– 18,000
,, United States	1,000	46,000	+ 45,000
,, Denmark	7,000	6,000	– 1,000
,, Germany	14,000	55,000	+ 41,000
Machinery, unenumerated, including detached parts, and not including agricultural, textile, or sewing machines.—			
Total	1,291,000	1,765,000	+ 474,000
From United Kingdom ...	539,000	602,000	+ 63,000
,, Japan	1,000	4,000	+ 3,000
,, United States	152,000	102,000	– 50,000
,, France	23,000	27,000	+ 4,000
,, Denmark	485,000	810,000	+ 325,000
,, Germany	29,000	139,000	+ 110,000
Railway material.—			
Total	1,739,000	1,949,000	+ 210,000
From United Kingdom ...	163,000	154,000	– 9,000
,, Belgium	1,008,000	357,000	– 651,000
,, France	569,000	1,417,000	+ 848,000
Cars or trucks for railways or tramways.—			
Total	675,000	241,000	– 434,000
From United Kingdom ...	600,000	202,000	– 398,000
,, United States	4,000	32,000	+ 28,000
,, Belgium	46,000	4,000	– 42,000
Rubber manufactures, other than tires.—			
Total	220,000	374,000	+ 154,000
From Singapore	128,000	279,000	+ 151,000
,, United Kingdom ...	53,000	50,000	– 3,000
,, United States	6,000	15,000	+ 9,000
,, Japan	8,000	4,000	– 4,000
,, Germany	8,000	9,000	+ 1,000

NOTE.—Tical = 1s. 10½d.

The Performance of Radio Amplifiers.

Summary of the Radio Research Board's Experiments.

(Abstract of Paper read before the WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper by Mr. H. A. Thomas, M.Sc., describes the researches carried out at the National Physical Laboratory for the Radio Research Board. A standard method of testing the amplification and input impedance of an amplifier is described, and the theory of the load introduced by the amplifier as well as by reaction is shown to agree with the observed results. Unfortunately, any combination of valves used for amplifying, note-magnifying, and/or rectifying, is commercially regarded as an amplifier. Such an arrangement will be termed an "amplification system," and the term "amplifier" will be applied only to a combination of components fulfilling the purpose of pure high- or low-frequency amplification. Unless otherwise stated, the terms will include all battery and output connections, *i.e.*, the complete assemblage. The performance of any amplifier must be expressed in terms of three distinct properties:—(1) Its voltage amplification; (2) its effect upon the circuit to which it is connected, and (3) its distortion of wave-form, but the experimental work carried out has been insufficient for an attempt to be made to correlate any one property with any other. Valve noises, which in a multi-stage audio-frequency amplifier usually determine the limiting number of cascade valves, are not dealt with, being more a matter of valve design.

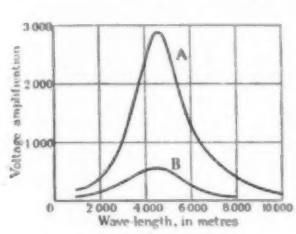


Fig. 1.

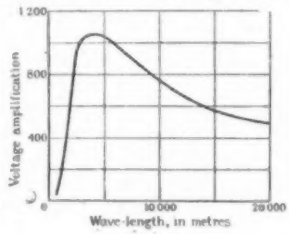


Fig. 2.

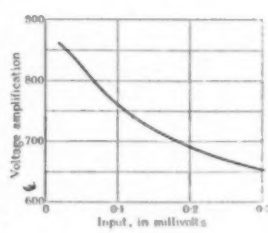


Fig. 3.

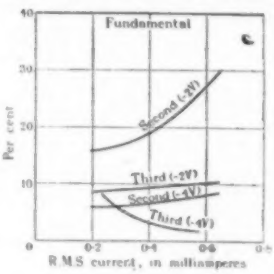


Fig. 4.

Section I deals with the measurement of voltage amplification and the results obtained show that so far as high-frequency amplification is concerned, apparently the net effect of the many factors which can only be approximated in design gives very variable figures for amplification. As an example two apparently identical 3-stage amplifiers, transformer coupled, gave the results shown in fig. 1. In curve A it is apparent that retroaction effects combine to increase the overall amplification, whereas in curve B the phasing is such as to reduce the amplification. Since such retroactive effects form an inherent property of any amplifier and are dependent upon inter-electrode capacities, stray lead capacities and leaks, it is reasonable to expect large variations between amplifiers built to similar specifications.

Fig. 2 gives the overall voltage amplification of a 6-stage resistance-capacity amplifier, which shows that below 4,000 m. the shunting effect due to the self-capacity of the anode resistances seriously reduces the amplification. The more gradual fall at higher wave-lengths is attributed to the fact that the coupling condensers are not large enough at the lower frequencies. Fig. 3 gives the amplification of a 6-valve untuned transformer-coupled amplifier with various inputs on the grid, from which it will be observed that the amplification appears to fall with increasing input. It has been stated by several authorities that the voltage amplification falls with weak inputs, but the inputs for which this effect is claimed are of the order of a few microvolts and are smaller than any input measured here. The curve in fig. 3 may therefore bend back to the origin, but no measurements have been taken to confirm this. The evidence for this effect may depend upon distortion which will seriously affect the r.m.s. value of the current and may not be a genuine reduction of amplification of the fundamental. The discrepancies arising due to a neglect of the harmonics present may be very serious. The behaviour of the detecting valve departs only very slightly from the theoretical square law; in fact, this law can in most instances be assumed.

The measurement of the voltage amplification of a low-frequency amplifier presents less difficulty. The inter-electrode impedances at low frequencies are large and their shunting effects almost negligible. Induction can be entirely eliminated with care, and measurements to less than ½ of 1 per cent. can be obtained. Several standard audio amplifiers were tested at a frequency of 1,000, and it was found that the overall amplification of several cascade stages was less than the product of the individual stages. A special experimental 2-stage amplifier was built with which very consistent results could be obtained. The effect of the high-pressure condenser of several microfarads was very pronounced, the amplification falling considerably when a smaller condenser was used, probably due to the resistance of the h.p. battery. Inserting a small capacity of 100-1,000 $\mu\mu$F between the two windings of the transformer slightly increased the amplification, due to the increase in the electrostatic coupling between the windings; a capacity of 1,000 $\mu\mu$F increased the amplification by 5 per cent. These tests show that it is possible to construct a 2-stage amplifier in which little loss takes place, if the components are judiciously separated. The maximum may be obtained, if separate high-pressure batteries be used for each stage without the use of a high h.p. condenser. Separate low-pressure batteries produce an increase of 4 per cent. in overall amplification.

The input impedance of an amplifier is studied in Section II; the amplifier may be considered as a resistance and capacity in series forming a load across the resonant system. The value of this capacity appears to be sensibly constant under all conditions, whereas the value of the resistance is dependent upon the value of the tuning inductance. The effects due to reaction can be expressed in terms of the known theoretical conditions.

In Section III distortion in audio-frequency amplifiers is considered and the following conclusions are drawn, remembering, however, that they are provisional only; considerably more experimental work is necessary to confirm the general conclusions so far obtained.

(i) The effect of *increasing output* is to modify the wave-form seriously. In general, the harmonics increase in magnitude far more rapidly than the fundamental.

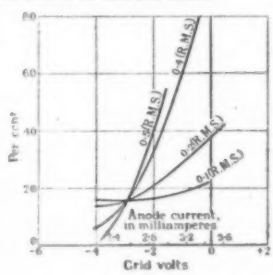


Fig. 5.

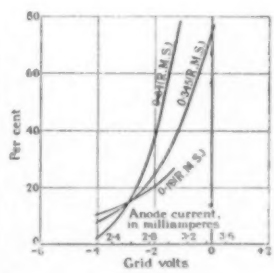


Fig. 6.

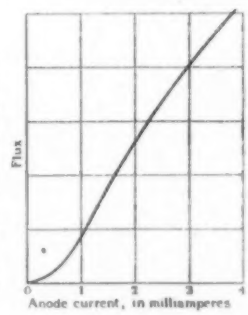


Fig. 7.

(ii) As the *frequency* is lowered, the distortion becomes much more serious. It is safe to say that at 150 p.p.s., the fundamental may be almost completely eclipsed by the harmonics with outputs of about 1 mA.

(iii) The effect of *negative grid bias* is to reduce the magnitude of the second and third harmonics and to introduce small harmonics of a higher order.

(iv) The *form factor* remains sensibly constant under most conditions.

(v) That the rapid growth of the higher harmonics (the fourth, fifth, and sixth) produces a critical distortion was noticed in many cases. The shape of the Lissajous figure quite appreciably changes with a very small increment of current beyond a given critical value. The form factor and other ratios are seriously upset in this case, and do not fall into the final inferences with smaller outputs.

(vi) In fig. 4 the percentages of the second and third harmonics are given for various outputs with different grid potentials; the rate of growth of the harmonics is much greater than that of the fundamental, thus demonstrating the rapid wave-form change as the amplitude of the sinusoidal input is increased.

(vii) In fig. 5 the ratio of the actual peak to the fundamental component peak is plotted for various output currents and

mean grid potentials and is expressed as a percentage greater than unity; the curves all intersect at a point corresponding to a mean negative grid potential of 2.9 volts. This means that the wave-form is *not altered* by increasing the magnitude of the output, and this condition is valid only at this point. Further, there is *definite distortion* leading to an error of 18 per cent. *which apparently cannot be removed by reducing the signal amplitude.*

(viii) The ratio of the actual peak value to the peak of a sine wave of the same r.m.s. value is plotted in fig. 6, from which a precisely similar result is obtained at the same mean grid-voltage condition. It seems probable that this condition is one defined by the normal d.c. anode-current component in the primary of the transformer, rather than any loading effect on the secondary, due to grid-filament impedance, which will be very large in all the cases considered. This grid voltage corresponds to 2.6 mA primary current. In Section I it is shown that the transformer voltage ratio is materially affected by the normal d.c. anode current, thus supporting this opinion. The shape of the *B-H* curve for the transformer is shown in fig. 7, from which it will be seen that the polarising flux brings the normal working point just at the beginning of the saturation bend. It is not easy, however, to observe any definite properties at this point.

It is apparent that the error between an r.m.s. determination of output and a fundamental wave determination as given by a resonant instrument may be often as much as 20 per cent. Further, the grid variation is much in excess of the theoretical as given by an r.m.s. measurement.

The general observations point to peak values giving the chief measure of output sound effect upon the human ear, and if this can be established it is clear that much modification will be necessary in our measurements of signal intensity.

Mining in other Countries.

Electric Power Plant in the Tropics and in South America.

(*Abstract of Paper read before the* ASSOCIATION OF MINING ELECTRICAL ENGINEERS.)

AT a recent meeting of the London branch of the above-named Association, Mr. H. M. Morgan described electric power plant at a group of collieries in the tropics, and also that at a group of metalliferous mines in South America, where the conditions are very different.

Tropical Collieries.—Steam, superheated to a total temperature of 500 deg. F., is generated by Lancashire and Babcock and Wilcox boilers; the latter are provided with Green economisers, chain grate stokers, and balanced draught. The large grates enable inferior fuel to be burned and, so far as is possible, the boilers are fed with condensate, and the make-up pit water has to be treated. As native labour is used it is advisable to render the plant as fool-proof as possible.

The generating station commenced in 1909 with one Belliss-Vickers set; two others were added later, and condensing plant has since been installed. The fourth set is a 500-kW, 2,200-volt, Belliss-G.E.C. condensing machine with a directly-coupled exciter, all the engines being capable of producing their full output at a reduced steam pressure—a useful feature for remote plant. The load is now normally carried by a Parsons reaction, 6,000-r.p.m., turbine driving a Mather and Platt, 1,430-kVA (at 0.7 p.f.), 2,200-volt, 25-cycle alternator at 750 r.p.m. through single-reduction cut gear, the exciter being directly coupled.

All the auxiliary plant is motor driven and the condenser air (steam) ejector has an intermediate condenser. The results in cheaper power production have been most marked, but at tropical collieries high atmospheric temperatures and a definite heavy rainy season have to be contended with. The condenser cooling water temperature has been as high as 98 deg. F., while that of the water pumped from the colliery workings has reached 94 deg. F. In the wet season with a dry bulb temperature of 84 deg. and the wet bulb thermometer at 81 deg., it is impossible to cool satisfactorily; Korting spray nozzles are used for water cooling purposes.

The cost of power, including labour, coal (a poor quality, picked out and charged at the average cost price of the whole output), stores and depreciation, is about 1¼d. per kWh for the non-condensing Belliss sets, say, at 350 kW; ¾d. per kWh for the condensing Belliss set, say, at 450 kW; and ½d. per kWh for the turbo-generator, say, at 800 kW.

The slate switchboard is by Erskine, Heap & Co., Ltd., whilst power transmission is by overhead lines at 2,200 volts throughout. Lightning arresters and choke coils are placed at every overhead bare transmission line end, of the horn and multigap types; in all cases there is a resistance in the earth circuit. The multigap type is preferred, but the arresters have not given full protection. At rare intervals there has been some damage to switchgear and joint boxes.

The poles are tubular or are rails; those for the 0.6 sq. in. (19/0.202 wires) line are 32 ft. long, 10½ in. diameter, reducing in two steps to 8¼ in. at the top. One conductor is carried on the pole top and two on a cross arm, giving 2 ft. 6 in. centres between conductors. The span is 270 ft. and the sag is about 9 ft., so that with the poles planted 5 ft. the minimum height of line above ground at centre of span is about 17 ft. The conductor weighs 2.4 lb. per foot. At bends towers are used made up of four poles well braced, and the terminal towers are also made up of four poles, but stronger than the angle towers. Disk strain and pin type insulators are used.

The end and angle towers are good for stresses of 12,000 lb. due to conductors. Single poles are good for a load of 2,240 lb. downwards and 1,100 lb. sideways at 2 ft. from the top. The disk strain insulators were subjected to a test pull of 12,000 lb. The pin type insulators were designed for a 1,000 lb. side pull applied at the conductor groove.

The type of cable most widely used is paper insulated, lead sheathed and double wire armoured. Formerly bitumen in various forms was used; it was all right at 440 volts, but gave trouble at 2,200 volts, and is not now used. In shafts the cables are rubber insulated and armoured. Junction boxes are usually of the "disconnecting link" type with glands arranged with a mechanical lead sheath seal, so avoiding wiped lead joints.

Electricity is supplied at 2,200 volts to the motors or to transformers which give a medium pressure of 440 volts for motors below 50 b.h.p. Transformers are of the core type, oil cooled, and vary in size for motors from 20 to 100 kVA and for lighting from 1½ (single phase) to 15 kVA (Scott connected).

The control gear for motors is of "mining" type, the equipment including voltmeter and ammeter, three-pole oil-break switch with two overload trips and one low-voltage release. Tank lowering gear is fitted which isolates the switch. The starting gear for motors is usually a liquid Sandycroft type interlocked in the case of haulage motors with an oil-break reversing switch for stator currents. The motors are commonly of the enclosed pipe-ventilated type with a temperature rise not exceeding 55 deg. F. on full load and with insulation chiefly of mica for withstanding a moist hot atmosphere. Motors for pumps and endless haulages are rated continuously and have brush-lifting and short-circuiting gear. Motors for intermittent haulage are one-hour rated and have extra heavy sliprings and brushes for continuous use. Recent motors have ball and roller bearings and means are provided for testing the air gap.

South American Mines.—The South American plant that is dealt with provides power for hoisting, pumping and milling at a group of metalliferous mines at a great elevation (from 12,000 to 14,000 ft. above sea level) in dry bare mountainous country where low temperatures are the rule. Fortunately a railway now reaches the area, so that heavy weights can be transported, though this was not always so.

The most convenient source of power is oil, and Diesel engines are the best prime movers. Beginning with two engines, the station now has four duplicate Diesel engines of the English Electric Co.'s make. Each has four cylinders and drives at 214 r.p.m. a 28-pole, 150-kW Peebles generator, three-phase, 660 volts, 50 cycles; neutral not earthed.

The b.h.p. of each engine is 326 at sea level, but only about 210 at 12,800 ft. above sea level, where the barometer reads about 19 in. Hg. and water boils at 190 deg. F. If the engines could be supplied with air at sea level pressure (say, 15 lb. per sq. in. absolute) they would give their sea level output, but when this plant was investigated it was found that of the 116 extra h.p. that the engine would give, 55 h.p. would be used in compressing the inlet air, leaving 61 h.p. as the gain. The cost of the compressor would be high and the money would be better laid out in purchasing a larger Diesel engine.

The thermal efficiency is reduced for the complete engine by having to drive the compressor for injection air, but, even so, the overall thermal efficiency is 34 per cent. The mechanical efficiency is about 72 per cent.

The distribution is extensive, and at various pressures: 660, 2,200, 6,600 and 11,000 volts. The overhead bare copper lines are carried on light steel tubular poles spaced about 40 metres apart and arranged for a minimum height of wire of 16 ft. above ground line. The wires are 16 in. apart for 2,200 volts; 16 in. apart for 6,600 volts; and 30 in. apart for 11,000 volts. An earth wire is carried on the pole tops and the conductors are supported on insulators on single brackets bolted to the poles.

Lightning storms are severe, and arresters of the oxide film type (General Electric Co., of America) have been called for recently, but not yet tried. As additional protection there is the earth wire, choke coils and a short length of cable between overhead line and transformers, whilst the end turns

of the transformers are specially reinforced as to insulation (Johnson & Phillips' standard practice).

The motors are for 600 volts, of the slip-ring and squirrel cage types mostly enclosed pipe-ventilated.

An interesting item of plant is a three-throw vertical sinking pump for 400 g.p.m., 300 ft. high (rams 9¼ in. by 11 in. stroke at 50 r.p.m.). The motor is enclosed pipe-ventilated and drip-proof, of the squirrel-cage type, started by an auto-transformer which is mounted on the pump frame. The motor runs at 720 r.p.m. and is of 50 b.h.p.; between it and the pinion is a centrifugal clutch so that the motor starts light and gets hold of its load on attaining speed. The first pair of gears are laminated to minimise backlash. The pump is by Frank Pearn, and the motor by the Lancashire Dynamo and Motor Co.

Discussion in London.

The branch president, Mr. J. W. GIBSON, said he had had experience of some of the peculiarities of the Indian coal referred to, with a 26 per cent. ash content. He believed there had been cases in which this coal had been powdered and fired as powdered fuel successfully. Could that coal be used successfully in Lancashire boilers without forced draught? The description of the three-throw pump was very interesting; he, himself, was handling a similar problem, and would be glad of information with regard to laminated gears.

Mr. A. C. SPARKS said the most startling thing in the paper was the 2,200-volt overhead transmission line, which was the largest he had ever heard of. In some of the big lines in this country there was only two-thirds the dead weight of copper that there was in the line referred to in the paper. The tension of the wires was low, and he asked if difficulty had been caused by the phases blowing together. Again, there appeared to be no switches installed in the line.

Mr. W. F. BISHOP said he had never come across an overhead transmission line with a conductor of the size mentioned by the author. Had the author experienced any trouble with the cable, due to the acidity of the water in the pits? He believed that considerable trouble had been experienced in that connection in some of the Mysore fields, and special precautions had to be taken to overcome the difficulty. Apparently, however, the author had rubber-insulated cables.

Mr. H. M. MORGAN, replying, said he would not like the impression to go out that 26 per cent. was the usual ash content of Indian coal. That was the worst that had been found, and his analysis had shown the ash content to be 12 per cent; the coal was very free burning, and did not clinker at the ordinary temperature of the Lancashire furnace, but it would clinker in a Babcock & Wilcox furnace because the temperature there was higher. It was a very favourite coal; in Bombay it was dear, and for that reason it was used only as a "sweetener" for some of the other coals. Powdered fuel plant had been installed at the Mint, Hyderabad, but for some reason it was not a success there. With Babcock chain grates, one could use the worst coal one had got in the sizes which the grates would take, which were generally down to about 1¼ in., and there was no need to pulverise. It cost about 2s. or 3s. per ton to pulverise, and why should he do it if it were unnecessary? He had pulverised some Indian coal and had made a short test with it, which was successful, but the test was not long enough to enable a conclusive decision to be arrived at. Lancashire boilers could be run without forced draught; most Lancashire boiler plant had 70- or 80-ft. chimneys, which would give all the draught needed to burn the coal successfully.

The dead weight on the transmission line poles, referred to by Mr. Sparks was within the weight for which the poles were designed, and there was a margin of safety. Regarding the phases blowing together, he agreed that the tension of the big cable was small; there were 90-yard spans, and a sag of 9 ft., which looked quite a lot, and the people concerned were rather afraid of the phases blowing together, but the line had experienced one stormy period without that occurring. There were tornadoes and cyclonic winds blowing in all directions, and the three wires might blow together, but he would expect all three wires to swing in the same direction at the same time and so keep apart; at any rate, they were heavy, and would have to cover a good arc before they would come together. If there were signs of trouble in that connection, it could be overcome by placing insulated spacers between the wires in the centre of each span. If transformers had been provided for that line it would have been a much better job, of course; it would have been cheaper, and there would have been better regulation and protection. All the feeder panels were equipped with a three-phase switch, with overload trips, but the slide was not sufficiently detailed to show them. He had not had trouble with the cables through acidity in the workings, chiefly because the cables could be kept dry. There was not very much trouble with ice, because the rainfall was small, and, although the temperature was low, there was a fairly strong sun. There were very strong wind storms and lightning storms, but there had been no trouble with the transmission lines, which were very small.

A High-pressure Cable Testing Outfit.

Messrs. Watson & Sons' Valve Rectification Apparatus.

THE experience gained in the manufacture of electro-medical and X-ray apparatus, which frequently employs very high voltages, has enabled Messrs. Watson & Sons (Electro-Medical), Ltd., to produce equipment for high-pressure cable and overhead line testing by means of hot-cathode valve rectification of h.p. alternating current. Although embodying a principle that has hitherto not been taken advantage of for this purpose, the plant seems to have passed the experimental stage, for it is claimed that such outfits have been satisfactorily used by municipal authorities, and one of the leading cable manufacturers.

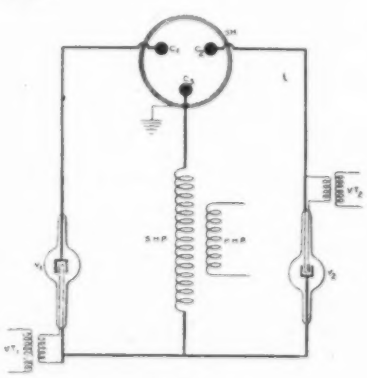


Fig. 1.—Diagram of Connections.

The principle upon which the hot-cathode valve depends for its operation is the fact that the highly evacuated space within a glass bulb containing two metal electrodes, one of which is made incandescent while the other remains comparatively cool, possesses uni-directional conductivity, so that current will pass through the valve only when the heated electrode is negative. The amount of current which can be rectified by such a device increases with the temperature of the heated electrode, but remains constant so long as the temperature of the latter remains constant.

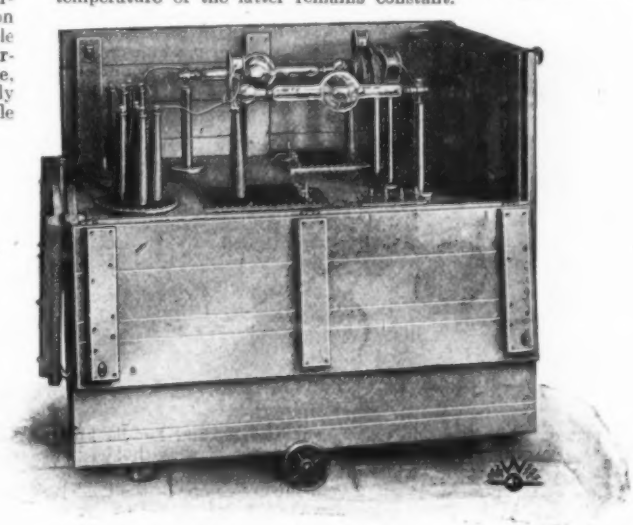


Fig. 2.—Control Cabinet and Rectifying Valves.

The essential parts of the one-ton testing outfit illustrated herewith are (*a*) the main h.p. step-up transformer, which weighs approximately 13 cwt., its overall dimensions being 51 by 30 by 63 in., and it is capable of a continuous output of 5 kVA at a secondary pressure of 75 kV r.m.s. (either terminal to earth) when connected with an a.c.

supply main or petrol-electric generating plant; and (*b*) two valve rectifiers with tungsten wire cathode filaments, two small transformers to furnish the heating current for the filaments, and means for controlling the voltage output of the plant, all of which is contained in the cabinet shown in fig. 2, which weighs approximately 7 cwt. and measures 41 by 63 by 57 in. Fig. 3 is an end view of the cabinet; the control gear proper comprises a 1-75-kW auto-transformer, a choke coil for intermediate adjustment, various meters, resistances, and an electrostatic 0-150-kV voltmeter in a

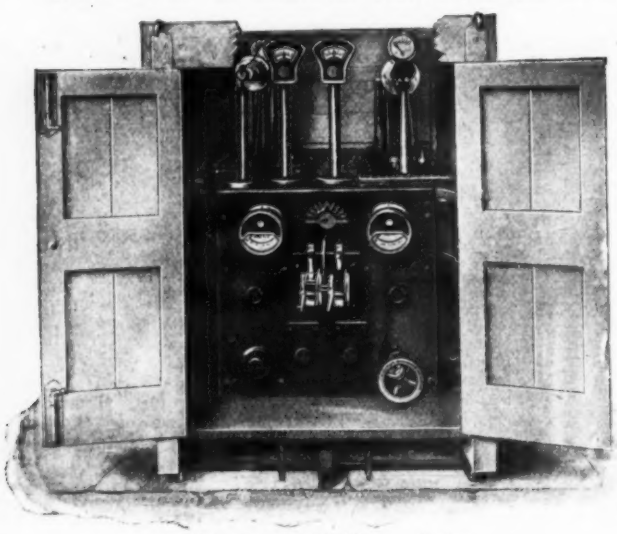


Fig. 3.—Control Cabinet ; end view.

separate carrying case. Direct current for testing is obtained by the rectification (by means of the valves) of the a.c. delivered by the main transformer and the utilisation of the capacity of the cable itself under test.

The diagram (fig. 1) indicates the method of connecting up the equipment; up to 150,000 volts may be applied between two cores and 75,000 volts between one core and earth. It will be seen that one end of the h.p. secondary winding of the transformer SHP is connected to the sheath SH of the cable, whilst the other end is connected to the anode of one of the valves and to the cathode of the other V_1, V_2. The cathode of the first valve is connected to one core of the cable, and the anode of the second to the other core C_1 C_2. The filament-heating transformers are marked VT_1 and VT_2.

When in operation, one-half of the sine wave from the transformer flows through the first valve and charges one core to a potential to earth equal to $\sqrt{2}v$, where v is the potential produced by the transformer. The second half of the wave flows through the other valve and also charges the second core to a potential to earth equal to $\sqrt{2}v$. Thus, between cores, there is a p.d. equal to $2\sqrt{2}v$, and at the same time there is a p.d. between cores and earth equal to $\sqrt{2}v$; usually the core not under test is connected to earth (C_2, fig. 1). These values are theoretically correct, but in practice, owing to leakage in the cable, which is, of course, a variable factor, the test voltage attained being usually a few per cent. below the value $2\sqrt{2}v$.

The method of connection to test one core at high voltage (up to 100,000 V) to earth is similar, except that C_2 and the sheath are earthed instead of C_1. With this method of connection it is possible to test one core to earth at a potential equal to $2\sqrt{2}v$, in which case use is made of one of the cores of the cable as a floating condenser, and the potential to earth on this core during test will be $\sqrt{2}v$. It will be noted that the anode of V_1 is connected to C_1—the core under test, one end of the h.p. winding SHP is connected to the cathode of V_1 and the anode of V_2, whilst the other end of the winding is connected to the "floating" capacity C_3; the cathode of V_2 is connected to the sheath of the cable.

Besides the 2-valve outfit referred to above, a single-valve model is obtainable capable of producing a test voltage up to 60,000 V between cores or from one core to earth. It is realised that apparatus of this kind is not an everyday commodity; only large commercial concerns or public authorities are likely to require it and, therefore, anything in the nature of mass production is not only undesirable, but quite impossible. Moreover, the circumstances in which the apparatus is to be used usually call for certain modifications. The above particulars must, therefore, not be regarded as a hard and fast specification, for we understand that the manufacturers are prepared to modify the equipment in any direction to suit the requirements of the user, and that they will be pleased to advise intending purchasers with regard to the manner in which adjustments may be made to render the apparatus most suitable for their purpose.

Selected Radio-Telephone Apparatus.

Recent Developments and Improvements.

"Lotus" Coil Holders.

We have received samples of the two- and three-way coil holders which are made by Messrs. Garnett, Whiteley & Co., Ltd., for outside panel and inside baseboard mounting. The moving block system comprises three sets of machine-cut gears that reduce the speed eight times. The gearing is hidden in the base under metal disks, all metal parts being nickel

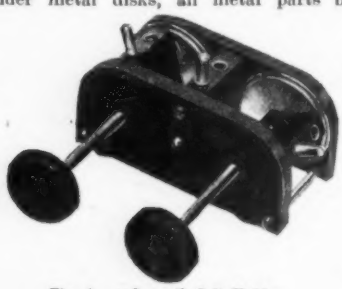


Fig. 1.—"Lotus" Coil Holder.

plated, while the side plates, coil holders, and handle knobs are Bakelite mouldings. The dimensions of these holders are about 2¼ by 2¼ in., while the depth, including the extension arms and knobs, is 4½ in. Fig. 1 illustrates one of the holders, the samples of which that were sent us being well made and enabling smooth and fine adjustment to be carried out.

Interesting Hospital Installations.

That broadcast radio entertainment is a boon to hospital patients is clearly demonstrated by the large number of institutions that have been equipped for the purpose. In most cases a multi-valve receiving outfit is employed with central control, in contrast to which practice an interesting installation has recently been completed in the Birmingham General Hospital. It consists of 45 B.T.-H. "Bijou" crystal receivers and 200 pairs of headphones. Four receivers are fitted in each ward, and six pairs of headphones are taken from each set, a connection being brought to each bed; indoor aerials are employed. This decentralised control system has proved very successful in practice: Since only six beds are connected to a particular instrument, that is the maximum number that would be affected by a temporary defect, and the possibility of defects arising in a crystal set are, of course, very remote, while it is possible to maintain a continuous service without any running cost whatsoever. The cost of the installation was very generously borne by the public in response to an appeal by the *Birmingham Gazette*, and the work was carried out by Messrs. Beresford Brothers, Birmingham, under the direction of the British Thomson-Houston Co., Ltd.

The Lincoln County Hospital installation was carried out on very serviceable lines by the Lincoln Wireless Co., Ltd. It is composed of a Marconiphone long-range V.2 receiver, with two amplifiers (voice and power types), which feed 126 'phone and 10 loud-speaker points, which are fed through specially designed "Ideal" line transformers. Another feature is the fact that the loud-speaker points also possess what is described as a unique form of compensating gear, whereby the balance of reproduction is not upset should the arrangement, or number, of loud speakers be varied from time to time. Three loud speakers of the "Mellovox" type have been supplied, and the 126 'phone points have been fitted with Sterling "Lightweight" headphones.

A Constructor's "Super-Het" Set.

There has been recently placed on the market by the General Electric Co., Ltd., a group of components which will enable anyone to construct a long-range selective "super-het." The group comprises the following:—Three intermediate-frequency transformers; filter; filter-tuning condenser; oscillator and terminal board covering approximately 200-600 metres; the full-sized blue print, which can be used as a template for marking off both the front and the rear of the panel, and the detailed book of instructions should enable even the most inexperienced constructor to build a first-class 6-valve receiver. Those who de-

sire to embody "Gecophone" components additional to the group mentioned will find them all suitable for mounting on ¼-in. to ⅜-in. panels, and it is suggested that the most suitable valves to use with such a set are Osram D.E.3, which have a filament current of 0.06 amp.

The "Siftron."

The current output of a receiving set or amplifier comprises two components. One is uni-directional and upon it is imposed the second component, which is alternating in character, providing the means whereby the diaphragm of the loud-speaker is caused to vibrate and emit sound. The continuous component serves no useful purpose in reproduction and its exclusion from the telephonic windings would be advantageous, because the pole pieces that influence the diaphragm are already polarised by permanent magnets and any additional constant force tends only to unduly stress the diaphragm. For a loud-speaker that has its armature, reed, or diaphragm "balanced" by the application of initial magnetic effort, further energisation is not merely superfluous, but actually prejudicial, for the pole pieces will become supersaturated and the a.c. component will not vary the magnetic field to the same extent as would be the case were the direct component eliminated. The desired end may be attained by the use of the simple device shown in fig. 2 with its top cover removed. It is a product of Messrs. Alfred Graham & Co., comprising inductance and capacity housed in a Bakelite casing, and weighs 1¼ lb., its dimensions being 5 in. over terminals by 2¼ in. by 2¾ in. In fig. 3 A and B represent the output terminals of a receiving set or amplifier; these leads are bridged by an inductance C—a coil of relatively high impedance offering comparatively small resistance to the flow of direct current, but obstructive to alternating current. Across this impedance there are connected the windings of the loud speaker D in series with a condenser E of appropriate capacity, which is virtually an open path to a.c., but presents a closed door to the flow of d.c. Therefore the continuous current component flows through C, which constitutes a by-pass as it were, and the variable component through the coils of the loud speaker D *via* E. Thus the loud speaker input is in the form of modulated current only, and the instrument is enabled to function with the best effect. Such an arrangement is a sifter or filter circuit which, incidentally, offers the further advantage that it is unnecessary to join-up the loud speaker in any particular sense or direction. The values of the components have been accurately determined, and the "Siftron" is interposed between a receiving set and the loud speaker without altering any internal connections.

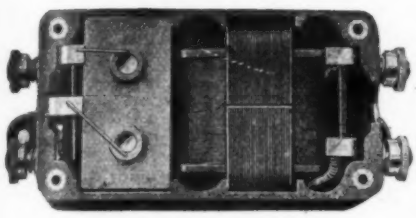


Fig. 2.—The "Siftron."

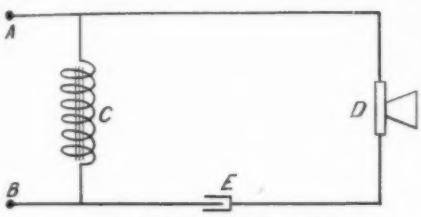


Fig. 3.—Diagram of Connections.

The Measurement of Coal.—In a paper read before the Manchester branch of the Institution of Civil Engineers, Mr. J. E. Lea, B.Sc., M.I.Mech.E., dealt with the question of the measurement by flow of solids, particularly coal. He showed that however much any mineral material might be broken or pounded up, its "homogeneousness" persisted, and, within fairly close limits, the weight per cubic foot of such broken and mixed up loose material did not vary very much under ordinary conditions. Also that for graded coals of any size, equal volume actually meant equal weight; a cu. ft. of ordinary mixed coal or slack, under ordinary conditions, did not weigh much more, if anything at all, than a cubic foot of graded nuts or peas. Mr. Lea also claimed that a given weight of actual coal occupied the same space whether wet or dry. Measurement by volume, he said, entirely ignored either the presence or absence of moisture, and therefore in many cases it was a truer measure of the actual coal than measurement by weight.

A Double-Bogie Electric Locomotive.

A Combined Battery and Trolley "English Electric" Shunting Engine.

For several years past the Castner-Kellner Alkali Co., Ltd., has been employing a combined battery-driven and overhead trolley collector locomotive for shunting duty about its Runcorn works, and so satisfactory did it prove to be that another was ordered from the English Electric Co., Ltd. The new locomotive recently commenced service and is illustrated in fig. 1, fig. 2 being an interior view of the driver's cab.

A part of the works' track, including a gradient and curve, is equipped with an overhead trolley line, the locomotives being driven by their batteries on the other parts of the track. The overhead line consists of a positive feed and a negative return wire, the voltage between the two wires being 190 volts d.c. Current is collected from the wires by means of two pantographs placed side by side on the roof of the locomotive and operated by compressed air.

Fig. 1.—A Battery-Trolley Electric Shunting Locomotive.

The "N.I.F.E." battery on the locomotive was manufactured by Batteries, Ltd., Redditch, and consists of 146 cells of the nickel-iron type, having a capacity of 650 ampere-hours at the four-hour rate of discharge. The battery is carried in two halves in compartments in front of and behind the cab. Each half battery is in two iron crates fitted with lifting eyes so that it can be lifted bodily from the locomotive for repairs.

The locomotive is of the unarticulated, four-axle, double-bogie type; the cab is central and has large windows to provide ample vision for the driver. Each axle is driven by a 42-h.p. series railway motor through spur gearing running in oil. The four motors are of the 200-volt DK 75C self-ventilating type. Two drum, series-parallel, controllers are fitted in the cab, one for each direction of travel, and all controls are duplicated so that the driver can control the locomotive from either driving position. The change-over-switch has three positions (trolley, battery, and charge), and is fitted in the cab, interlocks making it impossible to move this switch when

Fig. 2.—Interior of Driver's Cab.

the locomotive is in motion. In the same way, the main controllers are locked when the battery is being charged.

The Westinghouse motor and air-compressor are mounted in the cab and the compressed-air cylinders are fitted at the ends of the battery compartments. The two air-operated pantographs are controlled by a valve placed beside the Westinghouse brake control; straight air and hand-operated screw pattern brakes are provided.

The voltmeter, ammeter, and ampere-hour meter are mounted on a panel between the windows, as are also the switches controlling the head, tail, and instrument lights.

All eight wheels are sanded by means of Westinghouse ejector valves and sand boxes placed on each bogie, the operation being controlled by foot-operated air valves placed beside the controllers at both driving positions and making sanding possible in both directions of travel.

The leading particulars are as follows:—

Type	0-4-40
Track gauge	4 ft. 8½ in.
Total adhesive weight	38 tons
Weight per driving axle	9.5 tons
Diameter of wheels	36 in.
Length over buffers	30 ft. 10 in.
Tractive effort on tread of wheels:—	
(*a*) Continuous	10,000 lb.
(*b*) One hour	16,000 lb.
(*c*) Maximum	20,000 lb.

The Tungstone Accumulator.

A Cell with Machine-made Parts.

A NEW lead storage cell has been placed on the market by the TUNGSTONE ACCUMULATOR CO., LTD., for which many advantages are claimed. It is put forward especially for use on motor-cars, for starting, lighting, and ignition; and for the high-pressure batteries of wireless sets. For the former purpose it is made in two standard sizes: 12-volt, 54 plates, weighing 89 lb. complete without acid, and 6-volt, 27 plates, weighing 48 lb., the capacity being 50 Ah at the 20-hour rate of discharge in both cases. For wireless sets a 60-volt battery weighing (without acid) 23 lb. and having a capacity of 3 Ah is made.

The essential feature of the new cell appears to be the adoption of mechanical processes as completely as possible in the manufacture of the plates and containers. The component parts are made by the Tungstone High-pressure Die-Casting

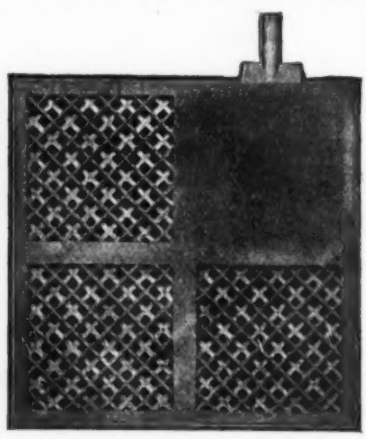


Fig. 1.—Four-section Tungstone Plate, one Section Pasted.

Co., with special automatic machines, and are of standard dimensions so as to be interchangeable. The basis of the design is a grid unit of pure lead, die-cast under high pressure, the present standard size being two inches square; the grid has evenly-spaced diagonal lattice ribs, with a strong frame, all of pure lead. These grids can be used singly, but for the larger cells are built up into plates by welding their frames together with antimonial lead; for this purpose semi-circular grooves are provided in the outside edges of the grids, so that when two grids are placed together a hollow channel of circular section is formed between them, into which molten antimonial lead is forced, permanently joining the grids. At the same time the groove round the periphery of the built-up plate is filled with antimonial lead, binding the whole together and providing increased conductance. It is claimed that this combination of pure lead for the active plate in contact with the paste, and antimonial acid-resisting lead for the supporting frame, is highly advantageous, increasing the life and efficiency of the cell.

The plates are pasted with pure lead oxides, with no inert admixture, in a patent pasting machine; the grids are totally immersed in the paste during this operation, and the paste is simultaneously fed under pressure to both sides of the grids, without exposure to the air, a process which, it is claimed, is entirely novel, and can be applied to any size of plate. Incidentally, the risk of lead poisoning is materially reduced by the extended use of machinery in the manufacture of the plates.

The patent Tungstone container is made of antimonial lead by die-casting in one piece, and is claimed to be immune from the infirmities that overtake containers of other materials, besides withstanding continued vibration. The lids are also die-cast with bosses to receive rubber pads, and vent plugs, in one piece.

The sections are built up of plates having lugs cast integral

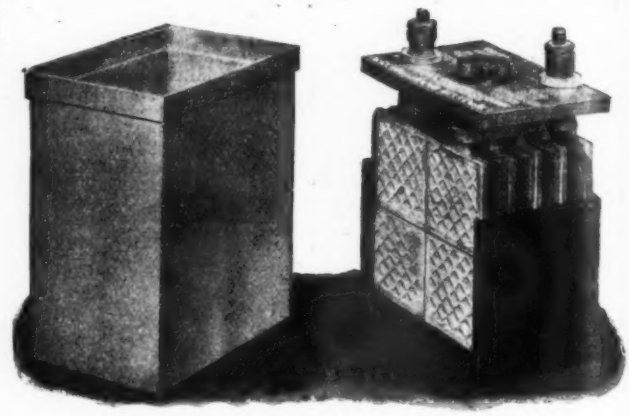


Fig. 2.—Container and Plates, with Lid and Ebonite Rests.

with the die-cast antimonial lead frames, the lugs passing through die-cast holes in bridge pieces; lead "burning" is not required, and any plate can be renewed without the use of heat. The bridge piece carries a strong terminal post, to which the coupling link is attached by a lead-coated Vislok nut. The sections are supported inside the container by a removable ebonite plate-rest and spacer at each end, grooved to receive the individual plates. There are no separators between the plates, and therefore the whole of the space is available for electrolyte, which is dilute sulphuric acid of sp. gr. 1,285, rising to 1,800 when fully charged. The lid fits snugly o a narrow ledge die-cast on the inside of the container, and can only be put on in the right way.

For use as car starting and lighting batteries, the cells are assembled in a wooden box with a sliding lid, fitted inside with rubber buffers; any complete cell or set of plates can be lifted out without disturbing the remainder.

The plates are formed at the makers' works and are given a partial first charge. The batteries are all sent out dry, and are filled with acid by the purchaser; after a rest of two hours they are charged at the full rate for five hours.

Fig. 3.—Standard 12-volt Car Battery.

The wireless cells each consist of a pair of plates two inches square in a glass container encircled with rubber bands, the containers standing on a rubber mat. An ebonite lid is sealed on the container, with an ebonite vent plug. The cells are coupled together with antimonial lead connectors, burnt on to the lugs, and provided with sockets for wander-plugs. Used on a 3-valve set, the 60-V battery is estimated to require fully re-charging about every six months; it is delivered dry and partially charged, and may be used without charging, two hours after filling with acid, but should be fully charged after a month's working.

Tungstone cells are all-British in design and manufacture.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

C.T.S. Trailing Cables.

We note a reference in your current issue, in a paper by Mr. I. Sclar, to accidents having occurred with cab-tire trailing cables with an earth wire incorporated in the cable, and he suggests that if the earth conductor had taken the form of an outside flexible metallic tube, such accidents would not have happened.

Mr. Sclar is evidently not aware of the fact that the present standard practice in trailing-cable design is to have a braid of tinned copper wires *surrounding* all live conductors, so that these can hardly be damaged without this earthed braiding cutting off current.

St. Helens Cable and Rubber Co., Ltd.
J. H. C. BROOKING, *General Manager.*

Slough, *January 1st*, 1926.

The Salaries of Combustion Engineers.

On reading the article on "The Combustion Engineer" in your issue of December 25th, my sympathy went out to Mr. C. F. Wade, who, a chartered engineer, has apparently always had the misfortune to meet engineers (?) who will persist in condemning turbine pumps and who will try to run their boilers in series; under such circumstances one can quite understand his nominating a "chemist with engineering inclinations" to such an exalted position. May I, however, point out that the chemistry of combustion engineering is very seldom the lot of the average chemist, but is it so very simple that any engineer may render himself quite conversant with it in a very short period? Combustion engineering is not simply a case of chemistry—to be a good combustion engineer one must first be an engineer; all the principles involved demand that such be the case—take the turbine pumps, for instance.

That there is much room for improvement is not disputed. Some time ago I spoke of a method that is daily gaining popularity; I was saved from annihilation at the hands of eminent engineers by Mr. D. Brownlie and Mr. Leonard Harvey. May I suggest that if engineers were allowed to have the necessary boiler-room instruments and if more notice were taken of their suggestions, the necessary improvement would be attained without adding to the staff a highly paid chemist of doubtful engineering ability. For the greater part engineers have to operate their plants with no other instruments than the gauge and water column. I am speaking as a shift engineer who, after a marine shop training on the Clyde, joined the power plant field in America. I have been right through the mill in a large American power plant, and in the process of becoming shift engineer in charge had to pass through as boiler-room superintendent and combustion engineer. In American practice the shift engineer is often termed "chief engineer," and in any case is in absolute charge of the station and the personnel thereof during his shift. It would be interesting to learn whether there are chemists at such stations as Dalmarnock or Barking to see that the shift engineer in charge does not attempt to put the boilers in series.

As I am an honours graduate and hold the diploma of America's largest college of combustion engineering, may I be permitted to sign myself

Another Combustion Engineer.

December 26th, 1925.

Whilst there is a certain amount of truth in some of Mr. C. F. Wade's statements, as set forth in his article on December 25th, it is equally obvious that a few of them ought not to go unchallenged.

To put the theme of the article into a nutshell is to infer that, in matters pertaining to combustion, the average charge engineer is a "dud," and his chief a bigger one for appointing him. Furthermore, he should command a lower salary than an engineer who has taken, say, Mr. Wade's full course on combustion. In addition, this student of combustion—or shall we say, expert?—is to be in sole charge of the steam generation, whilst the charge engineer will nominally be responsible for the whole plant.

On this showing I am afraid Mr. Wade's notions of power-station efficiency will not meet with universal approval among operating staffs, as such proposals would immediately cause discontent and thus lead to inefficient results. I assert that the charge engineer of to-day, who has had over 15 years' experience as a charge engineer, and has kept himself *au fait* with all necessary technical literature, will produce better combustion results than any other class of engineer, who has learnt all he knows about combustion from a 12 months' course by correspondence. In a 6,000-kW station not 20 miles from Sheffield, having a maximum load of 3,000 kW, the coal figures per unit generated are often below 2 lb. with a load factor of 20 per cent., and these figures are not obtained by any chemist, B.Sc., or combustion student, but by experienced charge engineers who have been at the game all their lives, and have gained their notions of combustion from everyday routine.

If Mr. Wade deplores the low salaries chiefs offer his students, he ought to remember the old adage—the market value of an article is just what it fetches.

J. G. T.

December 29th, 1925.

Service in Emergency.

As a member of the Institutions of Mechanical and Electrical Engineers, I have received (although employed in the electricity supply industry) two similar inquiries as to what I would be prepared to do and where I would like to go in case of national emergency.

Surely the Institutions and/or the Government would be better employed, if continuity of electricity supply is their aim, in persuading (or possibly legally compelling) undertakings which are not at present parties to the National Joint Board for Electricity Supply and the National Joint Industrial Council to join these schemes, for it is doubtless more satisfactory to eliminate the possibility of a national emergency than to provide, or try to provide, for dealing with it when it arrives.

In the provinces, municipal undertakings and supply companies generally are sound-minded, but there are some, in the London area especially, which have ideas of their own, which in the opinion of the majority are not conducive to industrial peace, and with the advent of the super-station and the ambition of its owners to spread its tentacles far in all directions, to my mind the limitation of dividends and the control of tariffs are not more important than the question whether the undertakings concerned are prepared to abide by the decisions of properly constituted Whitley Councils with regard to the conditions of employment of the staff and manual workers.

A.M.I.E.E., A.M.I.Mech.E.

London, *January 4th*, 1926.

Overhead Distribution.

The intervention of the Christmas holidays prevented my answering Mr. S. E. Glendenning's letter of December 19th, last week. As I have no intention of continuing this correspondence, which can be of no general interest, I would simply say:—

1. The printing error certainly fogged the original statement somewhat.
2. I was under the impression that Mr. Glendenning's original complaint was mainly on account of the guard wires, where the line has had to cross the telephone wires owing to the difficulty in obtaining wayleaves. Now, apparently, the mangled trees are having his sympathy. I would suggest that he visit Brundall early in May, when he will probably find that the mangled trees only exist in his imagination.
3. An e.h.p. overhead line across country, keeping two fields off, is excellent in theory. I hope Mr. Glendenning will some time have the opportunity of planning such a line, and will personally deal with the wayleaves. Farmers would welcome lines of trees through their fields, I have no doubt (?).
4. The six-mile line from Norwich conveys current at 6,600 volts; convert this to 400 volts between phases, and there is every probability that it would have been placed overhead instead of underground, on account of cost.
5. I decline to split hairs on the question of interest on capital on the two systems, but as a member of the I.E.E. Mr. Glendenning can surely work out to his own satisfaction the actual cost of overhead *versus* underground, for any given set of conditions.

Finally, I hope that with the long-promised Government assistance for rural distribution schemes, there will be ample opportunity in the near future for both overhead and underground systems to be employed.

G. Redgment.

Norwich, *January 2nd*, 1926.

Assisted Wiring.

With reference to Mr. H. T. Young's letter in your issue of January 1st, may I point out that to find a name for a complaint does not contribute to the removal of its cause. Influenza is a case in point.

I am glad to see that Mr. Young and the contractors whom he knows are generally in favour of this development, and will co-operate with it. But there are others (Mr. Young admits that he knows one) who are not in favour of it, and others still who damn it with faint praise and hypothetical objections.

Mr. Young asks who has been chiefly responsible for developing the installation side of the industry in the last thirty years. I would rather ask who, or what, has been responsible for the disastrous fact that it has *not* developed to anything like the extent it should, and that even otherwise backward countries are far ahead of us in the domestic use of electricity.

I have no experience of conditions in the United States. It may be that the American wiring contractor, like the American workman, has different ideas from ours as to the amount of work he ought to do.

I do not follow Mr. Young's remarks as to gas showrooms. Does Mr. Young really think that there are none, or that, if there are, they are not visited? I write in a London suburb, and within a 1d. 'bus ride of where I sit there are three really

palatial gas showrooms. A postcard or a telephone call to any of them will bring a representative ready to quote very low rates for any gas installation required. Of course our commodity is immeasurably superior to theirs in many respects, but do not let us delude ourselves into thinking that they do not know how to sell it, or that they make the mistake of over-charging for the consuming devices because they have no installation contractors to compete with them. The truth is that their policy is just the opposite.

The great British public cares nothing about a monopoly of it gives good service.

My *nom-de-plume* provides its own explanation and justification, and I again sign myself unrepentantly,

A Manufacturer's Salesman.

January 2nd, 1926.

X-ray Apparatus.

Our attention has been drawn to certain remarks made by the chairman of the General Committee of the Coventry and Warwickshire Hospital with regard to X-ray apparatus.

According to the *Birmingham Post*, this gentleman is reported to have stated that British X-ray couches are heavier, more difficult to manipulate, and just about three times as expensive as the German models.

The chairman did not apparently vouchsafe the simple explanation of this disquieting fact, *viz.*, that British radiologists demand a degree of "protection" for the operator against the harmful effect of the rays which is considered to be quite unnecessary in Germany. The X-Ray Protection Committee has accordingly drafted a series of recommendations with which British manufacturers are usually asked to comply, and frequently to more than comply, but which the foreign maker can disregard.

If the apparatus to be supplied to the Coventry and Warwickshire Hospital is to be as well protected and as universal as the best British product, then it is *not* a fact that the latter is one whit more heavy or cumbersome, but if these considerations are disregarded the remarks of the chairman are not altogether incorrect. Even so, the cost of the very best British X-ray couch is not £270, or anything like it, and, quality for quality, British manufacturers have nothing whatever to bemoan; in fact, there are few industries that have held their own so well.

Newton & Wright, Ltd.
R. S. WRIGHT.

London, *December 29th*, 1925.

[This matter is referred to in our leading columns.—EDS. ELEC. REV.]

Trade-Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from December 30th, 1925. In the case of foreign applications, the names and addresses of the British representatives are also given :—

Marconite. No. 464,176. Class 1. Insulating varnishes.—Marconi's Wireless Telegraph Co., Ltd.

Hicycle (lettering and design). No. 462,945. Class 6. Portable electric machine tools and current generating machines for operating such tools.—Chicago Pneumatic Tool Co., New York. (W. Brookes & Son, 5, Chancery Lane, W.C.2.)

Mippophone. No. 453,067. Class 8. Instruments and apparatus for use in radio-telephony.—M. I. Vaughton, 88, Vyse Street, Birmingham.

Operadio. No. 463,632. Class 8. Radio receiving sets and parts thereof.—The Operadio Corporation, Chicago. (Boult, Wade & Tennant, 112, Hatton Garden, E.C.1.)

Silvotone. No. 563,967. Class 8. Instruments and apparatus for use in radio-telegraphy.—W. S. Life, 32, West Street, Southport.

Pipsopan. No. 463,973. Class 8. Radio receiving apparatus.—A. J. A. Archdale, 32, Dawson Crecent, Torquay.

Annulex. No. 463,948. Class 11. X-ray vacuum tubes for surgical or curative purposes.—C. Anderson, 47, Red Lion Street, High Holborn, W.C.1.

Ebonold. No. 463,828. Class 50. Hard rubber goods of the nature of vulcanite or ebonite.—Clayton Rubber Co., Ltd.

Published Specifications.

Compiled expressly for this journal by Patent Agents.
The name of the applicant's patent agent, if any, will be found on the printed specification.
The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1924.

13,791. "Electric discharge devices, such as thermionic tubes and the like." Dr. E. F. Huth Ges. June 5th, 1923. (217,230.)

13,937. "Systems for the propagation and reception of Hertzian waves." L. Levy. June 6th, 1923. (217,245.)

14,130. "Electrical connectors." J. D'A. Clark. June 11th, 1924. (244,136.)

14,264. "Closed circuit electrical regenerative motor systems." W. P. Durtnall. June 12th, 1924. (244,137.)

14,459. "Wireless distant control apparatus." E. Fiamma. June 14th, 1924. (244,139.)

19,217. "Testing and measurement of audition." Standard Telephones and Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co., Inc.). August 13th, 1924. (244,147.)

20,993. "Electric discharge tubes." F. S. McCullough. April 3rd, 1924. (231,881.)

21,099. "Vibrating devices, particularly applicable to siphon recorders." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co., Inc.). September 6th, 1924. (244,154.)

21,217. "Electric welding systems." British Thomson-Houston Co., Ltd. (General Electric Co.). September 8th, 1924. (244,155.)

21,370. "Method of transmitting speech by high-frequency waves." E. Habann. October 2nd, 1923. (222,848.)

21,379. "Sound-reproducing and amplifying apparatus, such as phonographs and loud-speaking apparatus for wireless telephony." G. G. De Andia-Yrarrazaval. September 10th, 1924. (244,162.)

21,398. "Sound boxes for electrical transmission for loud-speakers, telephones and the like." C. Lindstrom Akt.-Ges. July 26th, 1924. (237,544.)

21,411. "Process of, and apparatus for the electric transmission of images." A. Dauvillier. November 29th, 1923. (225,516.)

21,435. "Impulse transmitters for use in telephone or like systems." Automatic Telephone Manufacturing Co., Ltd. March 15th, 1924. (230,779.)

21,436. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. March 28th, 1924. (231,419.)

21,486. "Means and methods for electrodepositing nickel, cobalt, or nickel alloys." E. Potter (Madsenell Corporation). September 11th, 1924. (244,167.)

21,487. "Means and methods for electrodepositing nickel, cobalt, or nickel alloys." E. Potter (Madsenell Corporation). September 11th, 1924. (244,166.)

21,508. "Receiving apparatus for high-frequency signalling systems." N. P. Hinton and Metropolitan-Vickers Electrical Co., Ltd. September 11th, 1924. (244,169.)

21,509. "Telephone instruments." W. S. Stephenson and G. W. Walton. September 11th, 1924. (Cognate application, 14,815/25.) (244,170.)

21,510. "Multiple aerial for wireless signalling systems." C. Lorenz Akt.-Ges. September 11th, 1923. (221,818.)

21,591. "Magnet structures for telephone receivers and the like." W. J. Palmer. September 12th, 1924. (244,175.)

21,952. "Space discharge tube systems for the manipulation of high-frequency currents." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co., Inc.). September 17th, 1924. (244,190.)

22,258. "Metal-enclosed electrical switchgear." Ferguson, Pailin, Ltd., S. Ferguson, and G. Pailin. September 20th, 1924. (244,193.)

22,419. "Electrical apparatus for the measurement of the level and flow of liquids and the height or movement of a body." G. F. Shotter. September 23rd, 1924. (244,195.)

22,429. "Thermionic valves." S. Hector. September 23rd, 1924. (244,196.)

22,859. "Frames or casings for panel boards for supporting wireless or other apparatus." W. Walker and Radio Communication Co., Ltd. September 27th, 1924. (244,200.)

22,964. "Crystal detectors for wireless apparatus." F. J. Rundle. September 29th, 1924. (244,201.)

23,107. "Automatic telephone instruments." Sterling Telephone & Electric Co., Ltd., R. H. Dougan, and J. R. Penney. September 30th, 1924. (244,202.)

23,772. "Loud speakers." A. H. Watkins. October 8th, 1924. (244,210.)

23,938. "Crystal rectifiers for radio reception." British Thomson-Houston Co., Ltd., and J. Hutt. October 9th, 1924. (Cognate application, 729/25.) (244,214.)

24,236. "Electrolytic rectifiers." A. B. Muntyan. October 19th, 1923. (223,561.)

25,371. "Wireless receiving apparatus." J. W. Combe. October 24th, 1924. (244,227.)

25,545. "Electrical operation of railway points and signals." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd. October 27th, 1924. (244,230.)

25,564. "Electrical condensers." Dubilier Condenser Co., Ltd. (formerly Dubilier Condenser Co. (1921), Ltd.). (W. Dubilier). October 27th, 1924. (244,231.)

26,053. "Alternating-current relays." L. H. Peter and Westinghouse Brake & Saxby Signal Co., Ltd. November 1st, 1924. (244,234.)

26,071. "Devices for use in connection with telephonic reception." W. M. Manning. November 1st, 1924. (244,237.)

26,648. "Variable electric condensers." J. R. Barnhart. April 9th, 1924. (232,166.)

26,951. "Metering of calls in telephone systems." Siemens Bros. & Co., Ltd., D. A. Christian and W. G. Patterson. November 11th, 1924. (Addition to 200,928.) (244,244.)

27,939. "Electrical switches." R. Woods. November 21st, 1924. (244,247.)

28,143. "Electric connection fitting." M. J. Railing and F. G. Quance. November 24th, 1924. (244,249.)

28,397. "Electro-magnetic inductance coil holders or mountings." E. Whiteley and Garnett, Whiteley & Co., Ltd. November 27th, 1924. (244,251.)

30,530. "Radio transmitting circuits." Telefunken Ges. für Drahtlose Telegraphie. December 22nd, 1923. (226,556.)

30,799. "Insulator structures for electrostatic condensers and the like." I. P. Rodman. March 8th, 1924. (230,417.)

1925.

389. "Selecting switches for use in telephone systems." Siemens and Halske Akt.-Ges. and K. Giese. January 6th, 1925. (244,281.)

949. "Grid leaks, anode resistances, and the like." M. Koopman. January 12th, 1925. (244,284.)

2,539. "Switches for electric water-heating apparatus." K. F. Henneman and P. Kerkhoven. December 1st, 1924. (Addition to 206,834.) (243,663.)

2,584. "Wireless receiving apparatus and condensers therefor." S. Williams and L. Williams. January 29th, 1925. (244,294.)

3,420. "Electric induction motors." British Thomson-Houston Co., Ltd. February 9th, 1924. (228,928.)

6,635. "Protective device for compensated asynchronous motors." Deutsche Werke Akt.-Ges. March 12th, 1924. (230,830.)

8,368. "Dynamometers." Dr. M. Kurrein. March 29th, 1924. (231,524.)

9,167. "Electric drive for machine tools, particularly planing machines." Siemens-Schuckertwerke Ges. April 7th, 1924. (231,904.)

10,950. "Pneumatic power transforming apparatus." H. Wade (Soc. d'Electricité et de Mécanique Procédés Thomson-Houston et Carels Soc. Anon.). April 27th, 1925. (244,330.)

11,688. "Alternating-current bell." M. B. Richter. August 5th, 1924. (238,188.)

13,464. "Production of oscillating currents by static transformers and the like." Telefunken Ges. für Drahtlose Telegraphie. May 23rd, 1924. (234,517.)

14,465. "Brush gear for dynamo-electric machines." Metropolitan-Vickers Electrical Co., Ltd. June 24th, 1924. (236,182.)

14,828. "Manufacture of electric lamps and similar electric devices." Naamloose Vennootschap Philips' Gloeilampenfabrieken. June 7th, 1924. (235,229.)

14,875. "Adding or differential watt-meter relay." Measurement, Ltd. September 11th, 1924. (239,828.)

16,643. "Rectifiers for wireless reception." S. J. Eintracht and E. J. Dickins. June 29th, 1925. (244,348.)

16,871. "Incandescent cathode X-ray tubes." Naamloose Vennootschap Philips' Gloeilampenfabrieken. November 20th, 1924. (Addition to 208,109.) (243,310.)

16,782. "X-ray tubes and installations for operating same." Naamloose Vennootschap Philips' Gloeilampenfabrieken. March 25th, 1925. (244,350.)

21,674. "Electrical gas purification." Lodge Cottrell, Ltd. (formerly Lodge Fume Co., Ltd.). (Metallbank und Metallurgische Ges.). August 29th, 1925. (Addition to 177,117, as modified by 238,480.) (244,372.)

23,234. "Telegraph signalling systems." Standard Telephones & Cables, Ltd. (formerly Western Electric Co., Ltd.). (Western Electric Co., Inc.). August 7th, 1924. (Divided application on 241,327.) (244,025.)

23,506. "Electric rectifiers." International General Electric Co. Inc. September 26th, 1924. (240,453.)

25,647. "Telephonic apparatus." V. A. Foot. September 6th, 1924. (Divided application on 243,102.) (244,384.)